

EXHIBIT A

United States Patent [19]

Tracy et al.

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[45] Date of Patent: Oct. 16, 1990

[54] **PASSIVATION COATING FOR FLEXIBLE SUBSTRATE MIRRORS**

[75] Inventors: C. Edwin Tracy; David K. Benson, both of Golden, Colo.

[73] Assignee: The United States of America as represented by the United States Department of Energy, Washington, D.C.

[21] Appl. No.: 259,634

[22] Filed: Oct. 19, 1988

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 873,069, Jun. 4, 1986, Pat. No. 4,780,372, which is a continuation of Ser. No. 632,742, Jul. 20, 1984, abandoned.

[51] Int. Cl.⁵ G02B 5/08; G02B 7/18

[52] U.S. Cl. 350/641; 350/164; 350/166; 350/320

[58] Field of Search 350/641, 642, 582, 164-166, 350/320; 428/428, 434, 460-463

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Primary Examiner—Bruce Y. Arnold

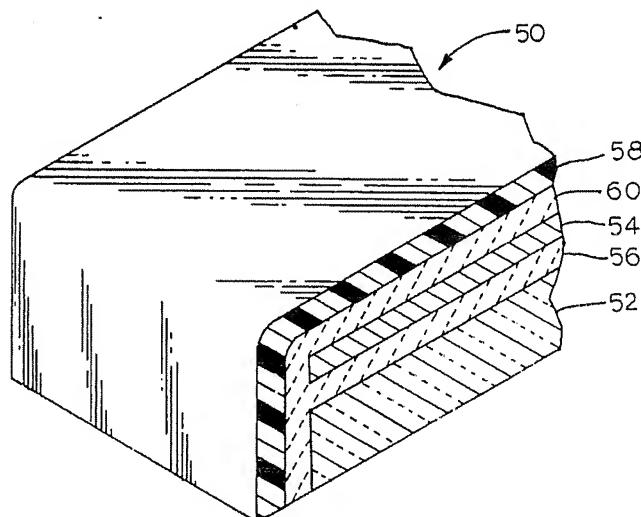
Assistant Examiner—Thong Nguyen

Attorney, Agent, or Firm—Kenneth Richardson; John M. Albrecht; William R. Moser

[57] **ABSTRACT**

A protective diffusion barrier for metalized mirror structures is provided by a layer or coating of silicon nitride which is a very dense, transparent, dielectric material that is impervious to water, alkali, and other impurities and corrosive substances that typically attack the metal layers of mirrors and cause degradation of the mirrors' reflectivity. The silicon nitride layer can be deposited on the substrate before metal deposition thereon to stabilize the metal/substrate interface, and it can be deposited over the metal to encapsulate it and protect the metal from corrosion or other degradation. Mirrors coated with silicon nitride according to this invention can also be used as front surface mirrors. Also, the silver or other reflective metal layer on mirrors comprising thin, lightweight, flexible substrates of metal or polymer sheets coated with glassy layers can be protected with silicon nitride according to this invention.

25 Claims, 6 Drawing Sheets



U.S. Patent

Oct. 16, 1990

Sheet 1 of 6

4,963,012

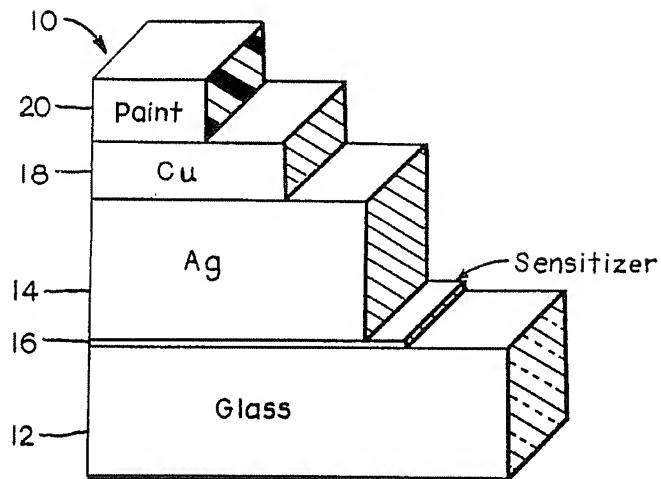


FIG. 1

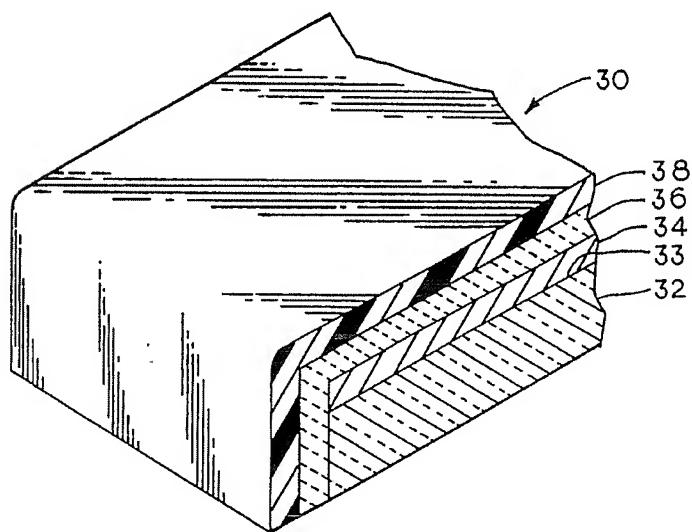


FIG. 2

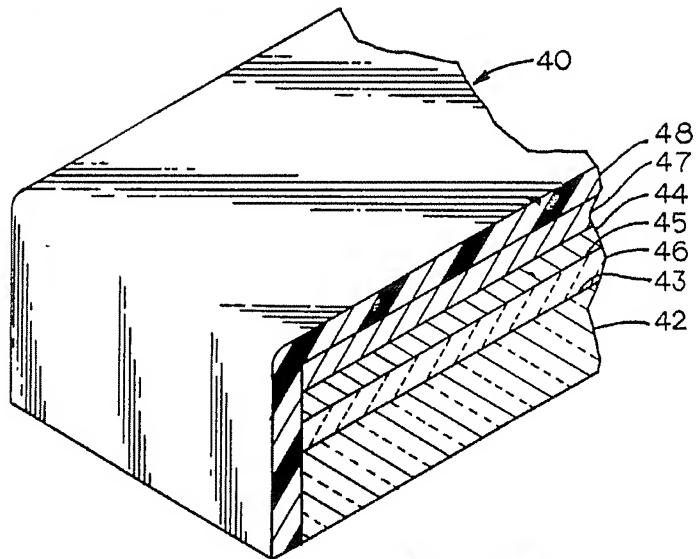


FIG. 3

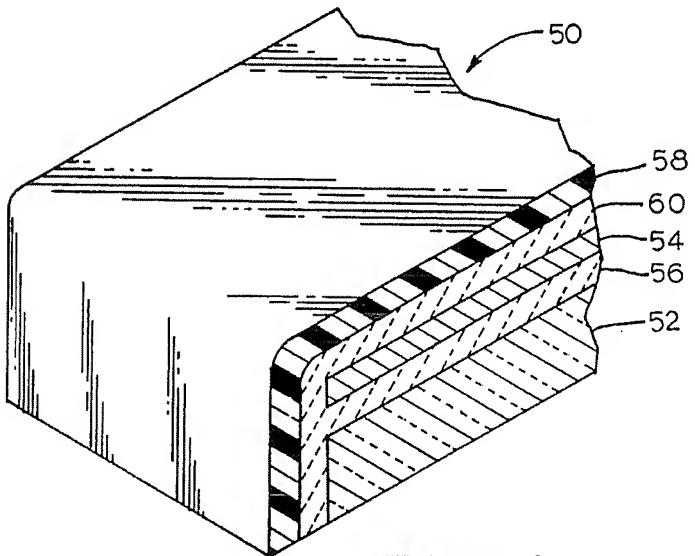


FIG. 4

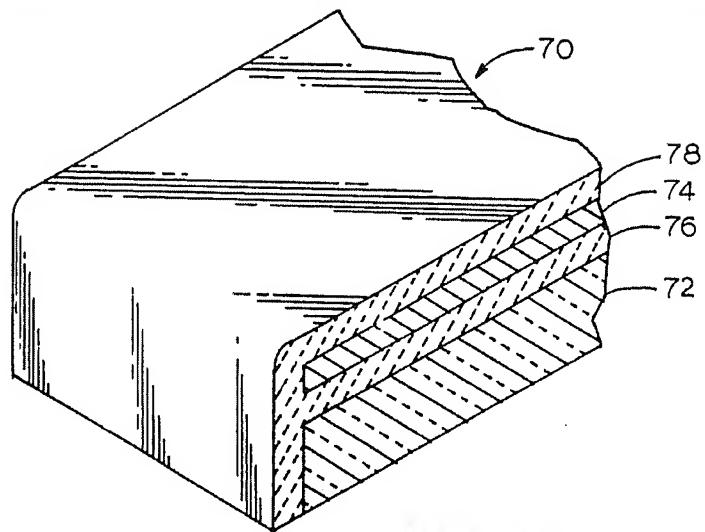


FIG. 5

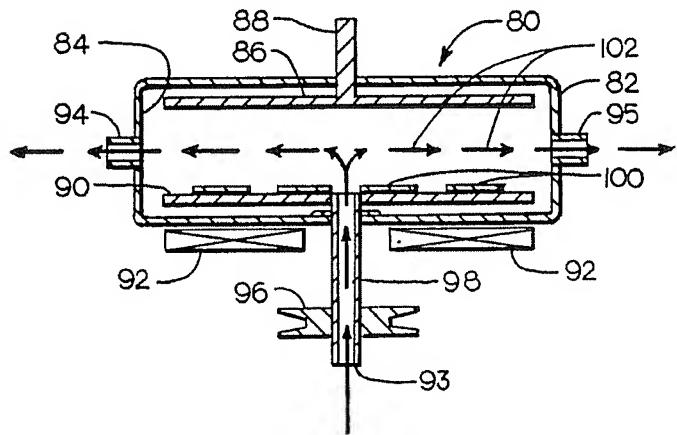


FIG. 6

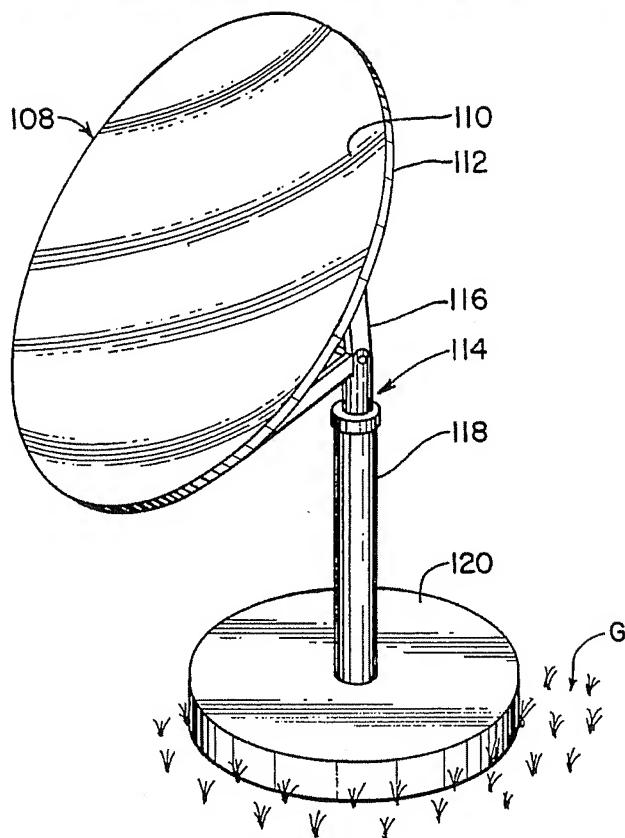


FIG. 7

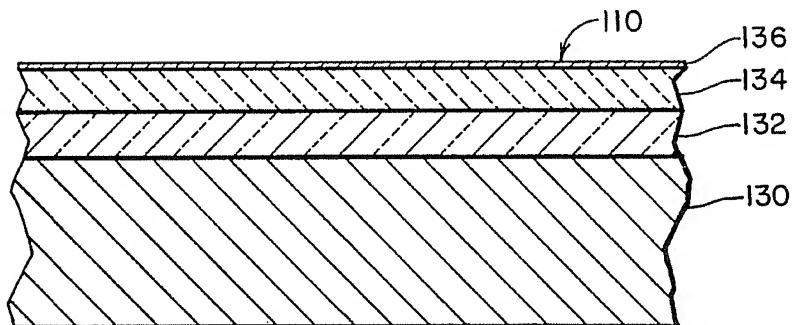


FIG. 8

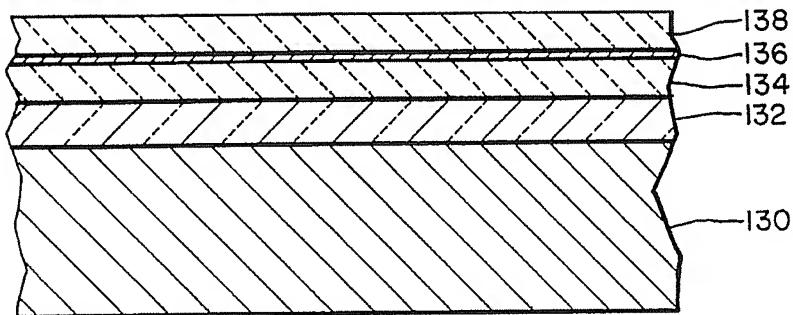


FIG. 9

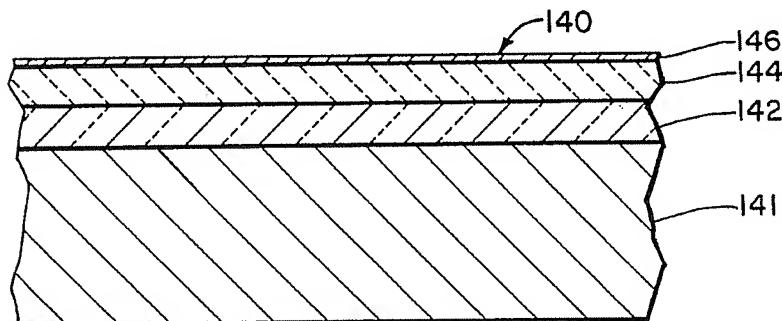


FIG. 10

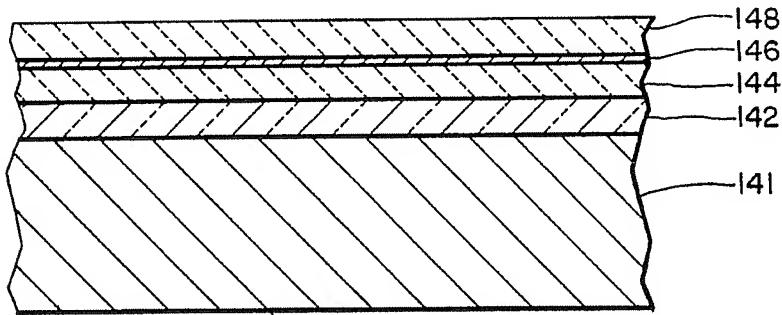


FIG. 11

U.S. Patent

Oct. 16, 1990

Sheet 6 of 6

4,963,012

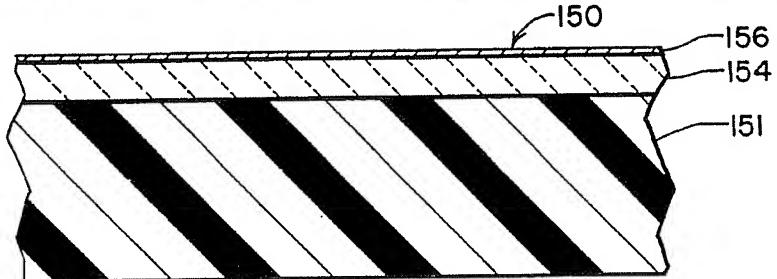


FIG. 12

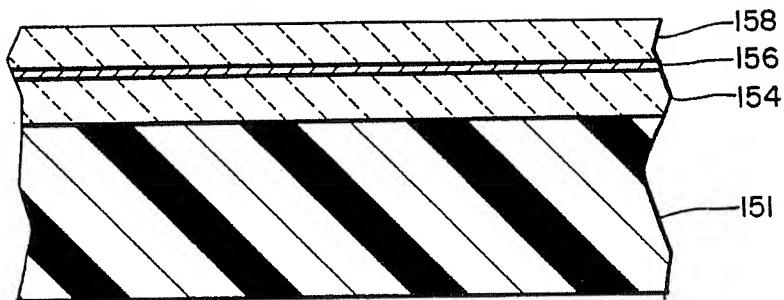


FIG. 13

**PASSIVATION COATING FOR FLEXIBLE
SUBSTRATE MIRRORS**

CONTRACTUAL ORIGIN OF THE INVENTION

The U.S. Government has rights in this invention pursuant to Contract No. DE-AC02-83CH10093 between the U.S. Dept. of Energy and the Solar Energy Research Institute, a Division of the Midwest Research Institute.

BACKGROUND OF THE INVENTION

1. Reference to Related Patent

This is a continuation-in-part of copending U.S. Pat. Application, Ser. No. 06/873,069, filed June 4, 1986, now U.S. Pat. No. 4,780,372, which was a continuation of U.S. Patent Application, Ser. No. 06/632,742, filed July 20, 1984, now abandoned.

2. Field of the Invention

The present invention relates to mirrors and, more particularly, to a passivation layer for the reflective silver or other metal layer of a flexible mirror to protect the reflective metal layer from degradation.

3. Description of the Prior Art

Most commercial mirrors are silvered glass composite structures wherein a thin layer of silver is deposited on the surface of a glass substrate to reflect light. Silver is preferred because its reflectivity is significantly greater than other metals, although other metals can be used. A common commercial process for fabricating such mirrors is known as a wet chemical electroless process, wherein a thin layer of chemically reduced silver is precipitated onto a sensitized glass surface. In order to protect the silver layer from damage and degradation, a protective coating is applied to its exposed surface. A common protective coat comprises a copper layer deposited over the silver layer, with a thick enamel paint spread over the copper layer. The copper layer interposed between the silver and paint layers enhances adhesion of the paint to the silver. A typical composite silvered glass mirror structure is shown in FIG. 1.

Silvered glass mirrors structured as described above have been used indoors without significant problems for many years. The more recent interest in use of mirrors for solar collector applications, such as heliostats, has resulted in more outdoor test installations of mirrors. While such tests have indicated economic feasibility of mirrored solar collector concepts from an energy standpoint, they unfortunately also revealed that conventional silvered glass mirrors do not stand up very well in outdoor environments. In fact, the reflective properties of most conventional mirrors undergo substantial degradation of their reflective properties within several months to several years in outdoor environments, which is a relatively short time when a useful life of 20 years is generally considered to be a minimum design requirement for economical solar collector installations.

There have also been recent developments in using thin sheets of flexible, rolled metal, such as stainless steel or aluminum foil, for substrates in silvered or other reflective metal mirrors. These flexible sheet mirror structures are primarily used as large, lightweight heliostat mirrors and the like in solar collector applications. See, e.g., R. B. Pettit & C. J. Brinker, "Use of Sol-Gel Thin Films in Solar Energy Applications", SPIE Vol. 562, Optical Materials Technology for Energy Efficiency and Solar Energy Conversion IV, pp. 256-268

(1985). In such applications, SiO₂-based sol-gel can be used to planarize the surface of the metal foil substrate by producing a silicon dioxide (SiO₂) layer thereon. The silver or other metal reflector surface is then plated on the SiO₂ layer to produce a highly specular mirror surface. However, the reflective silver or other metal layer on such mirror structures has been found to be unstable and rapidly degrades when exposed to even room atmosphere. Prior to this invention, there was no suitable passivation method available to protect these new, lightweight, mirror structures.

The exact optical and mechanical degradation mechanisms of this physicochemical corrosion process are not well understood. Environmental and electrochemical tests have shown that the corrosion reaction that occurs at the glass/metal or SiO₂/metal interface of a mirrored surface is extremely sensitive to interfacial environment. It is believed that collection of humidity and chemicals normally found in the atmosphere in imperfections and crevices of the plated metal surface, fabrication chemicals, glass leaching, local hot spots and stresses, and photoactivation of the surface metals produce deleterious effects and cause large variances in the durability of mirrored surfaces.

Detailed surface analyses of mirrors degraded in outdoor environments have indicated several possible mechanisms for chemically induced changes at critical interfaces, such as at the silver/glass interface. Both iron and alkali metal ions have been found to concentrate at the silver/glass interface and are suspected of reducing the silver to glass bond strength and contributing to silver degradation when water diffuses from exposed edges or from coating flaws into the silver/glass interface. This interface is also weakened by the tendency of the glass to form a hydroxide gel layer on its surface. Such gel formation is promoted by the reduction of tin complexes (sensitizers) applied on the glass surface during the wet chemical electroless process of mirror fabrication, by water adsorbed on the glass surface from the air, and by other interfacial impurities that result from subsequent steps in the fabrication process, including copper plating and enameling or painting.

To fabricate a better mirror structure that is capable of withstanding outdoor use for prolonged periods of time, such as 20 years or more, without degrading its reflective properties, it is necessary to protect the critical interfaces in the mirror from such destructive chemical reactions. Prior to this invention, such protection for mirrors was unknown.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a novel protective barrier around the laminated layers of a mirror structure to repel any outside humid, contaminating, or corrosive environment.

It is also an object of the present invention to stabilize the silver/glass interface in a mirror structure to protect the integrity of the silver from deleterious chemical degradation.

Another object of the present invention is to provide a passivation method for protecting and prolonging the useful life of a thin sheet mirror structure that uses a thin, flexible metal foil or other thin sheet or membrane as a substrate.

To achieve the foregoing and other objects and in accordance with the purpose of the present invention,

as embodied and broadly described herein, the mirror structure of this invention may comprise a diffusion barrier layer of silicon nitride deposited on the glassy layer or coating of a substrate to form a diffusion barrier that is impervious to water and corrosive environment and a film of silver or other reflective metal deposited on the silicon nitride diffusion barrier. The layer of silicon nitride provided at the interface between the substrate and the silver provides a diffusion barrier against moisture, alkalis, and other impurities in the substrate reaching the silver.

This invention also includes the method of fabricating mirrors by depositing silicon nitride diffusion barriers both over and under the silver or other reflective metal on a substrate. Since silicon nitride is transparent and forms such a dense, effective diffusion barrier over the silver or other reflective metal, mirrors fabricated by this process can be used as front reflective mirrors.

Additional objects, advantages, and novel features of the invention shall be set forth in part in the description that follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by the practice of the invention. The objects and the advantages may be realized and attained by means of the instrumentalities and in combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of the specifications, illustrate preferred embodiments of the present invention and, and together with the description, serve to explain the principles of the invention. In the drawings:

FIG. 1 is a perspective diagrammatic block view of the structure of a conventional silver glass mirror constructed according to a common wet chemical electroless process;

FIG. 2 is an enlarged cross-sectional view in perspective showing a mirror constructed with a protective barrier according to this invention as a surface coating;

FIG. 3 is an enlarged cross-sectional view in perspective showing a mirror constructed with a protective barrier according to this invention at the silver/glass interface;

FIG. 4 is an enlarged cross-sectional view in perspective showing a mirror constructed with protective coatings according to this invention as both a silver/glass interface stabilizer and a surface coating with the silver/layer sandwiched therebetween;

FIG. 5 is an enlarged cross-sectional view in perspective showing a mirror constructed with protective coatings and used as a front face mirror;

FIG. 6 is a diagrammatic cross-sectional view illustrating a parallel-plate plasma reactor used to deposit the protective coating according to this invention;

FIG. 7 is a perspective, conceptual view of a heliostat structure equipped with a mirror surface constructed on thin sheet substrate for its lightweight, flexible attributes in solar collector applications;

FIG. 8 is an enlarged, cross-sectional view of a thin sheet mirror structure having a metal foil substrate planarized with SiO₂ and having a silver/SiO₂ interface passivated with a silicon nitride layer according to this invention;

FIG. 9 is a structure similar to that shown in FIG. 8 and also including a silicon nitride protective overlayer coating;

FIG. 10 is an enlarged, cross-sectional view of a thin sheet mirror structure comprising a polymer substrate and glassy layer with a silver/glass interface passivated with a silicon nitride layer;

FIG. 11 is a structure similar to that shown in FIG. 10 and also including a silicon nitride protective overlayer coating.

FIG. 12 is an enlarged, cross-sectional view of an alternate thin sheet mirror structure comprising a polymer substrate and a silver/polymer interface passivated with a silicon nitride layer; and

FIG. 13 is a structure similar to that shown in FIG. 12 and also including a silicon nitride protective overlayer coating.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A typical mirror structure 10 constructed according to the conventional wet chemical electroless process is illustrated in FIG. 1. It is a composite structure comprising of a glass substrate 12 with a layer of silver (Ag) 14 coated on the glass substrate surface. A sensitizer 16, usually consisting of a tin chloride, water, and hydrochloric acid solution, is deposited on the surface of the glass substrate 12 prior to the silver to enhance adhesion of the silver layer 14 to the glass substrate 12. A paint layer 20 is coated over the mirror in an attempt to protect the mirror from the environment. However, paint layer 20 does not adhere very well to the silver layer 14.

Therefore, a thin copper (Cu) layer 18 is first deposited on the silver layer 14, and the paint layer 20 is coated over the copper layer 18. The copper layer 18 also shields the silver layer 14 to some extent from the deleterious chemical degradation of the silver that could otherwise result from the ingredients and impurities in the paint layer 20.

The substantial degradation of silver/glass mirror structures 10 in outdoor environments, as discussed above, shows that the paint 20 and copper 18 layers do not provide sufficient protection.

The method of producing silver/glass mirrors according to this invention provides a much superior protective coating for both the silver layer and the silver/glass interface, where degradation of such mirrors normally occurs. This protective coating is preferably a silicon nitride material, which is a very dense, impermeable, and refractory, material that is a good dielectric and is thermally shock resistant. Silicon nitride also advantageously forms a strong, coherent, and chemically stable coating on the glass. In fact, silicon nitride is one of the few dielectric transparent materials available that has a structure dense enough not only to prevent permeation by water vapor but also to act as a diffusion barrier to many ions, including the alkalis, which attack the silver and the silver-to-glass bond.

A silicon nitride coating on mirrors is advantageous when applied in three ways. First, such a coating can be applied over the silver layer to encapsulate and hermetically seal the silver layer with the glass substrate. Second, the coating can be applied to the glass substrate surface prior to application of the silver. Third, of encapsulation and surface sealing with the silicon nitride coating combines the protective benefits of both the first and second methods.

The mirror structure 30 illustrated in FIG. 2 is an example of the use of the silicon nitride coating to cover and encapsulate the silver layer 34 with the glass substrate 32. As shown therein, the glass substrate 32 has

deposited thereon a layer of silver 34 by the conventional wet chemical electroless process. A sensitizer (not shown) is applied to the silver/glass interface 33 in this process, as described above and shown in FIG. 1. The silicon nitride protective coating 36 is then deposited, as shown in FIG. 2, over the silver layer 34 and around the edges to hermetically seal the silver layer 34 and silver/glass interface 33 from the exterior environment. A paint coat 38 can then be spread over the silicon nitride layer 36, if desired. Vacuum evaporation, sputtering, ion electroplating, and other metallic plating techniques can be used as well.

The silicon nitride layer 36 in this structure provides a protective barrier to permeation of water vapor and other impurities from and through the paint coat 38 to the silver layer 34 and into the silver/glass interface 33. Thus, degradation caused by these external substances is effectively inhibited.

The second embodiment of this invention is shown in FIG. 3, wherein the silicon nitride layer 46 is deposited directly on the glass substrate 42. The silver layer 44 is then deposited on the silicon nitride 46. The conventional copper 47 and paint 48 coatings are provided on the exposed surface of the silver layer 44.

This second embodiment does not provide as much protection from water vapor and impurities from and through the paint coat 48 as the first embodiment. However, a significant cause of degradation of conventional silver glass mirrors is migration or leaching of alkali and water vapor through the glass to the silver/glass interface where corrosion and other deleterious chemical changes occur that can destroy the integrity of the silver and degrade the reflective properties of the silver. Therefore, the silicon nitride layer 46 deposited on the glass substrate 42, as shown in FIG. 3, serves the dual purpose of preventing alkali migration from the glass 42 to the silver/silicon nitride interface 45 and acting as an hermetic seal to any outside water vapor, thus basically stabilizing the glass surface prior to silver metalization.

The third embodiment 50, shown in FIG. 4, combines the benefits of both the first embodiment 30 and the second embodiment 40 described above and shown in FIGS. 2 and 3. In this third embodiment 50, silicon nitride layers 56, 60 are deposited over both the glass substrate 52 and the silver layer 54. Therefore, as shown in FIG. 4, the silicon nitride layers 56, 60 completely surround and enclose the silver layer 54 in a hermetic seal. In this manner, the silver layer 54 is protected from diffusion of humidity and corrosive exterior environments as well as from leaching alkali and other impurities in the glass 52. A paint coating 58 can be provided over the composite structure, if desired.

It is also significant that the silicon nitride coatings provide sufficient protection so that the paint coating 58 can be eliminated. Therefore, as shown in FIG. 5, this structure can be used as a front surface mirror 70, which provides improved reflection and other optical properties not inhibited by transmission of the light through the glass substrate 72. A silicon nitride coating 76 is deposited on the glass substrate 72. The silver layer 74 is deposited onto the silicon nitride layer 76, and an enclosing layer of silicon nitride 78 is then deposited over the silver layer 74 and over the peripheral edges of these several layers 74, 76 and of the substrate 72. Since the silicon nitride layers 76, 78 are transparent, either side of the silver layer 74 can be used as the reflective surface of the mirror 70.

Silicon nitride is a product of the chemical reaction of silane, ammonia, and nitrogen induced by high temperature. A recently developed technique (not a part of this invention) utilizing a parallel plate, RF-powered plasma reactor, such as that illustrated in FIG. 6, is capable of producing a silicon nitride deposit from the chemical reaction of silane, ammonia, and nitrogen at temperatures in the range of 300° C. This technique is appropriate for depositing silicon nitride coatings on glass substrates used in mirror construction.

For purposes of illustration but not for limitation, the silicon nitride deposition process in the parallel plate plasma reactor 80 in FIG. 6 will be described. Other processes, such as sputtering, evaporation, ion plating, and the like could also be used. In this example, the reactor 80 has a housing 82 that encloses a chamber 84. A rotatable susceptor 90 is positioned in the chamber 84 and supported by a hollow rotating shaft 98. An electrode 86 is positioned in the chamber over and parallel to the susceptor 90, with an RF shielded power input 88 extending through the housing 82. Heaters 92 are positioned under the susceptor 90 for heating the chamber 84 to approximately 300° C.

A vacuum can be pulled on the chamber 84 through outlet ports 94, 95. The mixture of silane, ammonia, and nitrogen gas as is introduced into the chamber 84 through an inlet 93 in the hollow shaft 98. A rotation drive 96 imparts rotary motion to the susceptor 90, on which the substrates 100 to be coated are positioned.

In operation, the substrates 100 are positioned on the susceptor 90. A vacuum is pulled on the chamber 84, while the chamber 84 is heated to about 300° C. The mixture of silane, ammonia, and nitrogen gases is flowed through the chamber 84 over the substrates 100, as indicated by the flow arrows 102. An RF field is created between the electrode 86 and the susceptor 90. The combination of vacuum, heat, and electric charge in the chamber 84 creates a chemically reactive plasma of the gases, which results in deposition of a solid coating of silicon nitride on the substrates.

After the silicon nitride coating is deposited on the glass substrate, the silver can be deposited on the silicon nitride coating in a conventional process, such as wet chemical electroless deposition, vacuum evaporation, sputtering, or the like. Then the encapsulating coating of silicon nitride can be deposited by the process as described above over the silver layer to hermetically seal the mirror assembly.

Tests have indicated that reflectance of mirrors coated with silicon nitride is substantially the same as uncoated mirrors. Further, degradation of the silicon nitride coated mirrors in outdoor environments is greatly reduced from uncoated mirrors.

The foregoing is considered as illustrative only of the principles of the invention. For example, while this description and the explanation herein refer to silver mirrors on glass substrates, it should be understood that the structure and processes of this invention relating to silicon nitride diffusion barriers for mirrors is equally applicable to other metalized reflective surfaces, such as aluminum, copper, and the like. It is also applicable to other substrate materials, such as thin film ceramics, metals, and a variety of amorphous materials, including plastics, glassy sol-gel materials, and other amorphous materials that can withstand the temperature required for the silicon nitride deposition. Plastic materials in particular are much like glass in contributing to adverse chemical reactions that degrade silver or other reflect-

tive metals at the silver to substrate interface. Therefore, a silicon nitride coating between the silver and a plastic material in the substrate is effective to passivate the interface and retard or eliminate chemical degradation of the silver at the interface.

Present technology, as described above, requires approximately 300° C. temperatures, but future developments could result in lower temperature silicon nitride deposition processes. Further, the use of wet chemical electroless silver deposition processes in the description of this invention is for convenience only, since most commercial mirrors are fabricated by that or similar processes. This invention is equally applicable to metalized mirrors for which the reflective metal surfaces are deposited on the substrates by other processes, such as vacuum evaporation, sputtering, electroplating, or the like.

With some modifications, the silicon nitride passivation techniques of this invention can also be used with mirrors fabricated on flexible thin sheets or membrane substrates. Such thin sheet mirrors are currently being considered and tested for use on heliostats, parabolic troughs, and dishes in solar collector applications. Although silvered mirrors on glass substrates, such as those described above and shown in FIGS. 2-5, are also optically suitable for such heliostat and similar applications, they are too heavy, in-flexible, and fragile, and they require extensive, rigid support. On the other hand, the mechanical durability, structural strength, and flexibility of sheet metal substrates (e.g., stainless steel, aluminum, or copper foils) can minimize the costs of handling, shipping, and subsequent fabrication into solar mirrors. Furthermore, metal substrates are projected for use in stretched membrane reflectors for which glass substrates are totally inapplicable.

The smoothest commercially available stainless steel in thin sheet or foil form (0.001 to 0.040 in. thickness) has a peak-to-peak surface roughness in the range of 290 Å to 1000 Å. This rough surface cannot achieve the 90% specular reflectance requirement desired and needed for efficient solar collector applications, where the percent specular reflectance is an indicator of the quality of a mirror surface measured by the percentage of light reflected from the surface with an angle of reflectance equal to the angle of incidence with respect to the plane of the surface. Such roughness does not allow for direct mirroring of the steel with a silver reflective layer, because silver deposited or plated on the stainless steel foil substrate conforms to, and has the same surface roughness as, the underlying substrate. Furthermore, cathodic/galvanic corrosion mechanisms at a silver/stainless steel interface quickly degrade and destroy the silver layer.

Considerable research effort has been directed toward utilizing a silicon dioxide layer produced from sol-gel on the stainless steel or other metal foil surface before depositing the silver layer on the surface. See, e.g., R. B. Pettit and C. J. Brinker, *supra*. The sol-gel process basically uses metal alkoxides [M(OR)_n, where M=Si, B, Ti, Al, etc. and R is an alkyl group, e.g., CH₃, C₂H₅, C₃H₇, etc.] as glass precursors, which are then catalyzed to precipitate as thin, glassy films by an acid or base in alcohol solutions at elevated temperatures. At this time, silicon dioxide is the preferred sol-gel coating, but future developments could utilize other oxides. Therefore, for the purposes of this description, reference is made most often to silicon dioxide for convenience; however, it should be understood that this in-

ventive concept applies also to passivating silver and other metal interfaces with other sol-gel produced glassy or ceramic type oxides. Essentially, the stainless steel foil can be dipped in the sol-gel, air dried, and then heated to boil out the solvents. This process leaves a thin layer of silicon dioxide or other oxides on the stainless steel foil surface. Obviously, these sol-gel coatings are essentially thin film forms of bulk glass or ceramic.

The initial thrust of the sol-gel research effort was to provide a protective coating around the silver layer and, particularly, to prevent the corrosion of the silver layer at the silver/stainless steel interface. However, it was found that the silicon dioxide layer, which is essentially glass, does not prevent degradation of the silver and, in fact, may even contribute to the degradation, for the reasons discussed in the "Background" section above. Essentially, the silicon dioxide or glass is chemically incompatible with the silver layer in outdoor environments, which results in rapid degradation of the silver layer.

On the other hand, the silicon dioxide sol-gel process has been shown to be very effective in planarizing commercially available stainless steel foil sheets. A layer of silicon dioxide in the order of about 5,000 Å thick derived from the above-described sol-gel process effectively fills in the surface roughness of the stainless steel sheet and provides a smooth, planar surface on which to deposit the reflective silver layer. Silvered mirrors fabricated with this process have specular reflectance capabilities of sufficient quality to satisfy the optical requirements necessary for solar mirror applications.

In FIG. 7, a heliostat 108 is shown having a thin sheet, flexible silvered mirror 110 stretched over a frame 112 and mounted on a support structure 114. The support structure 114 can include a superstructure framework 116 on which the mirror frame 112 is mounted. The superstructure framework 116 is pivotally mounted on a pedestal 118, which is attached to a support pad 120 on the ground G. Examples of such heliostat and other solar mirror applications can be found in U.S. Pat. No. 4,487,196, issued to L. Murphy.

Referring now to FIG. 8, an enlarged cross-section of a thin sheet silvered mirror 110 according to the present invention and adapted for such uses as in heliostats and other solar mirror applications is shown. The mirror 110 comprises a thin, flexible metallic sheet 130, such as rolled stainless steel, aluminum or copper foil. The smooth, planar-surfaced layer 132, preferably glassy, silicon dioxide derived from sol-gel, as described above, coats the rougher surface of the metallic layer 130. The thin, metallic sheet 130 and planar-surfaced, glassy layer 132 form the lightweight, flexible, substrate for the silvered mirror 110.

A thin film of silicon nitride 134 is then deposited on the planar surface of the silicon dioxide layer 132 before the thin film, reflective, silver layer 136 is deposited on the substrate. Therefore, the silicon nitride layer 134 is sandwiched between the silver layer 136 and the substrate, which comprises the silicon dioxide or other glassy or ceramic layer 132 coated on metal foil 130. The silicon nitride layer 134 effectively passivates the silver/silicon dioxide (glass) interface by isolating those materials from each other, as described above for the silver mirrors on glass substrates. The result is a very durable, flexible, and lightweight silvered mirror structure 110 that has long useful-life capability with minimum degradation of the silver reflective layer 136.

For even further protection from environmental and adverse conditions, an additional exterior layer of silicon nitride 138 can be deposited over the silver layer 136, as shown in FIG. 9. This latter, exterior layer of silicon nitride 138, along with the interfacing, interior layer 134, completely encapsulates the silver layer 136 in silicon nitride, similar to the embodiment 70 shown in FIG. 5 and described above for the silvered mirror on bulk glass.

For example, and not for limitation, the metal foil 130 of the flexible mirror embodiment 110 can be thin-rolled stainless steel aluminum, or copper sheets or foil in the range of 0.007 to 0.010 inch (180 to 250 micrometers) thick. The glassy planarizing layer 132 can be about 10,000 Å (1 micrometer) thick; the silicon nitride layer 134 can be about 10,000 Å (1 micrometers) thick; and the silver layer 136 can be about 1000 Å thick. As in the bulk glass embodiments described above, a sensitizer (not shown) can be applied to the silicon dioxide layer 132 before the silicon nitride layer 134 is deposited thereon. The silicon nitride layers 134, 138 can be deposited as described above for the bulk glass mirrors, and the silver layer 136 can be deposited by any conventional technique, such as wet chemical electroless deposition, vacuum evaporation, sputtering, or the like. The sol-gel process described above is preferred for depositing the silicon dioxide or other oxide layer 132, because it fills the rough surface of the metal sheet 130 and leaves a smooth, planar surface for the silicon nitride 134 and silver 136 layers. Other deposition methods, like sputtering, would leave the silicon dioxide surface with the same contour or roughness as the underlying metal sheet, and the subsequent silicon nitride and silver layers would also have the same rough surfaces. Such rough surfaces, particularly of the silver surface, would cause larger cone angles of reflected rays, thus light scattering, rather than good quality, spectral reflectance. Also, as described above, other suitable metals, such as aluminum or copper, for example, can also be used instead of silver for the reflective layer 136.

FIG. 10 illustrates in cross-section another thin, flexible mirror embodiment 140 comprising a polymer plastic sheet 141 with a glassy layer 142 coated thereon for a mirror substrate. In this kind of embodiment, the glassy layer 142 would have to be deposited on the polymer sheet 141 by a different process, such as sputtering or vacuum evaporation, because the sol-gel process, at least with current technology, has to be heated to too high of a temperature to boil out the solvents, as described above. However, the polymer sheet 141 itself has very smooth, planar surfaces, so the glassy layer 142, as well as the subsequent silicon nitride 144 and silver 146 layers would also take on the same smooth planar surfaces. FIG. 11 is similar to FIG. 10, but shows an additional exterior silicon nitride encapsulating layer 148, as in the previously described embodiments of FIGS. 5 and 9.

As previously noted, the glassy layer 142 can be a thin film ceramic material, and the silicon nitride layer 144 is effective to prevent chemical degradation between the silver and the thin film ceramic as well. Therefore, for purposes of this invention, the glassy layer can be construed to include thin film ceramic materials as well as the more pure silicon dioxide and other traditional glassy products.

The embodiment 150 shown in FIG. 12 shows the interface silicon nitride layer 154 deposited directly on a thin sheet polymer substrate 151, with the silver layer

156 deposited on the silicon nitride 154. This structure is feasible without a glassy layer to provide a smooth, planar surface for the silicon nitride layer 154, because the polymer 151 already has a smooth, planar surface. Therefore, the silicon nitride layer 154 deposited on the polymer substrate 151 will have a smooth, planar surface, so the silver layer 156 will also have a smooth planar surface. FIG. 13 shows the embodiment 150 of FIG. 12 with an exterior silicon nitride layer 158 for encapsulating the silver layer 156, as in the FIGS. 5, 9, and 11 embodiments.

The embodiments 140 and 150 described above with substrates comprising polymer sheets 141, 151 have the advantage of planar surfaces on the polymer sheets 141, 151. However, the embodiment 110 with the substrate comprising a metal sheet 130 has the advantage of being much stronger, particularly in tensile strength, and is not so susceptible to stretching.

Since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents are considered to fall within the scope of the invention as defined by the claims which follow.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A mirror, comprising:
a substrate comprising a thin, flexible sheet of metal foil with a glassy material coating a surface of said metal foil;
a first diffusion barrier comprising silicon nitride deposited on said glassy coating of said substrate; and
a reflective layer of metal deposited on said first silicon nitride diffusion barrier such that said first silicon nitride diffusion barrier is positioned between the glassy coating of said substrate and said reflective layer of metal for preventing leaching and diffusion from and through the glassy coating of said substrate to the reflective layer of metal and for avoiding physical contact with, and chemical reaction between, the substrate and the reflective layer of metal.
2. The mirror of claim 1, including a second diffusion barrier comprising silicon nitride deposited on the side of said reflective metal layer that is opposite said first silicon nitride diffusion layer for sandwiching said reflective metal layer between silicon nitride diffusion barriers while keeping said first silicon nitride diffusion barrier between the substrate and the metal.
3. The mirror of claim 2, wherein said glassy coating comprises silicon dioxide.
4. The mirror of claim 3, wherein said glassy coating is derived from a silicon dioxide-based sol-gel.
5. The mirror of claim 1, wherein said metal layer comprises silver.
6. The mirror of claim 2, wherein said metal layer comprises silver and said first silicon nitride diffusion barrier is in contact with the entire surface of the silver that faces said substrate and said second silicon nitride diffusion barrier covers the entire surface of the silver that faces opposite the substrate such that the entire silver layer is sealed in silicon nitride and not exposed directly to either the substrate or the environment.
7. A mirror comprising a flexible sheet substrate, a thin diffusion barrier layer of silicon nitride deposited

on the substrate, and a thin film of reflective metal deposited on the silicon nitride layer.

8. The mirror of claim 7, wherein said flexible sheet substrate is comprised of a metal foil with a layer of glassy material coating a surface of the metal foil, and wherein said diffusion barrier layer of silicon nitride is deposited on said glassy material, such that said diffusion barrier silicon nitride layer is positioned between said glassy material and said reflective metal film.

9. The mirror of claim 8, wherein said glassy material comprises silicon dioxide.

10. The mirror of claim 9, wherein said glassy material is derived from a silicon dioxide-based sol-gel.

11. The mirror of claim 10, wherein said metal foil is comprised of thin-rolled stainless steel, and said reflective metal film is comprised of silver.

12. The mirror of claim 10, wherein said metal foil is comprised of thin-rolled aluminum, and said reflective metal film is comprised of aluminum.

13. The mirror of claim 7, wherein said flexible sheet substrate is comprised of a polymer.

14. The mirror of claim 8, wherein said glassy material comprises a ceramic.

15. In a reflective metallic mirror, wherein a layer of reflective metal deposited on a substrate comprising an amorphous material forms a reflective surface, the improvement comprising:

a protective diffusion barrier comprised of a layer of silicon nitride positioned between the reflective metal layer and the amorphous substrate material for protecting the reflective metal layer and the interface of the metal layer with the amorphous material substrate from exposure to harmful precipitates of moisture, alkalis, and other impurities during exposure of the mirror to ambient environmental substances .

16. The improvement of claim 15, wherein said substrate comprises a thin, flexible, metal foil sheet with an amorphous glassy material coating on one surface of the metal foil sheet, and wherein said layer of silicon nitride is deposited on said amorphous glassy material.

17. The improvement of claim 16, wherein said glassy material comprises silicon dioxide.

18. The improvement of claim 17, wherein said glassy material is derived from a silicon dioxide-based sol-gel.

19. The improvement of claim 16, wherein said glassy material comprises a ceramic.

20. The improvement of claim 16, wherein said reflective metal comprises silver.

21. The improvement of claim 15, wherein said substrate comprises a thin, flexible sheet of polymer.

22. A method for fabricating a long-lasting mirror capable of long-term use as an effective reflector in solar collector applications, said method comprising the steps of:

coating a surface of a thin, flexible metal sheet substrate with a planarizing glassy material; depositing a first diffusion barrier layer comprising silicon nitride on the glassy material coating; and depositing a reflective layer of metal on the surface of said first silicon nitride diffusion barrier that is opposite said substrate such that said silicon nitride diffusion barrier is positioned between the reflective layer and the glassy substrate coating.

23. The method of claim 22, wherein said reflective layer of metal comprises silver and said glassy substrate coating comprises silicon dioxide.

24. The method of claim 22, wherein said metal sheet substrate comprises thin rolled stainless steel foil.

25. The method of claim 22, wherein said metal sheet substrate comprises a thin rolled metal foil sheet selected from the group consisting of stainless steel, aluminum, and copper.

* * * * *

EXHIBIT B

FIG. 1

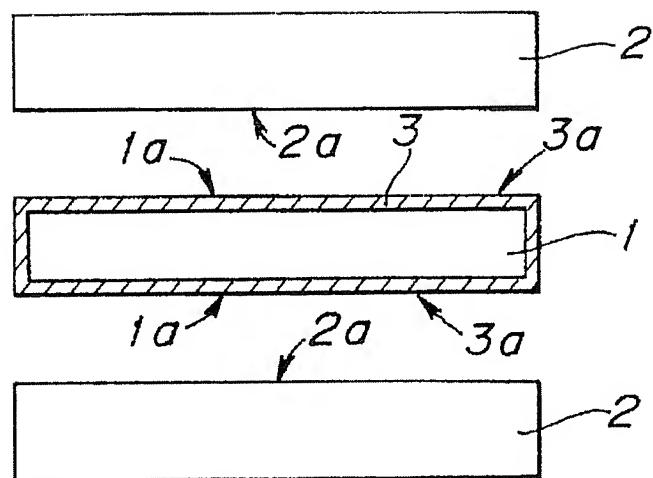


FIG. 2

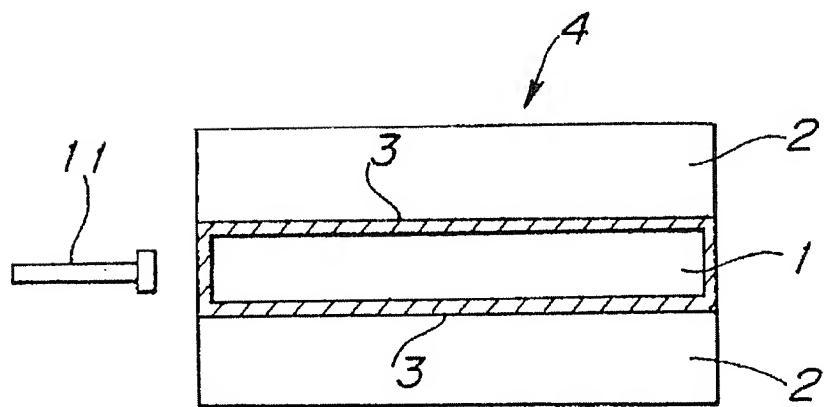


FIG. 3

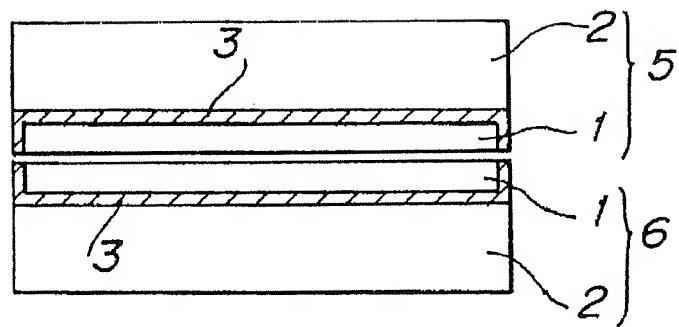


FIG. 4

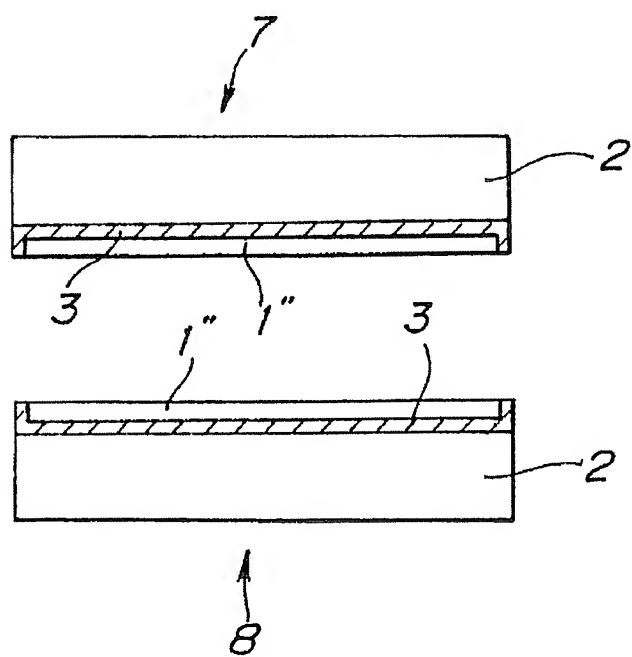


FIG. 5

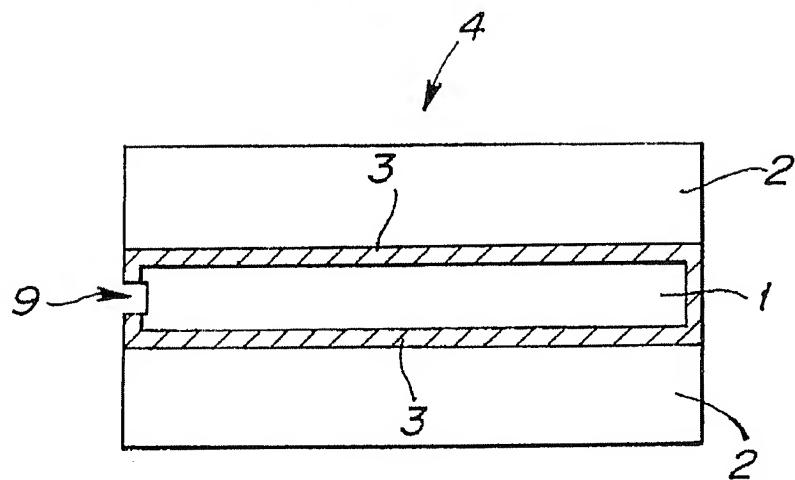


FIG. 6

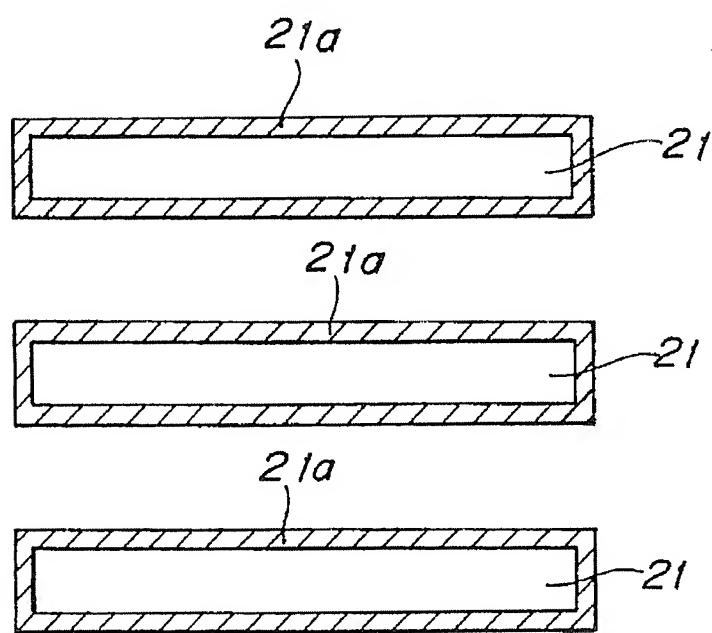


FIG. 7

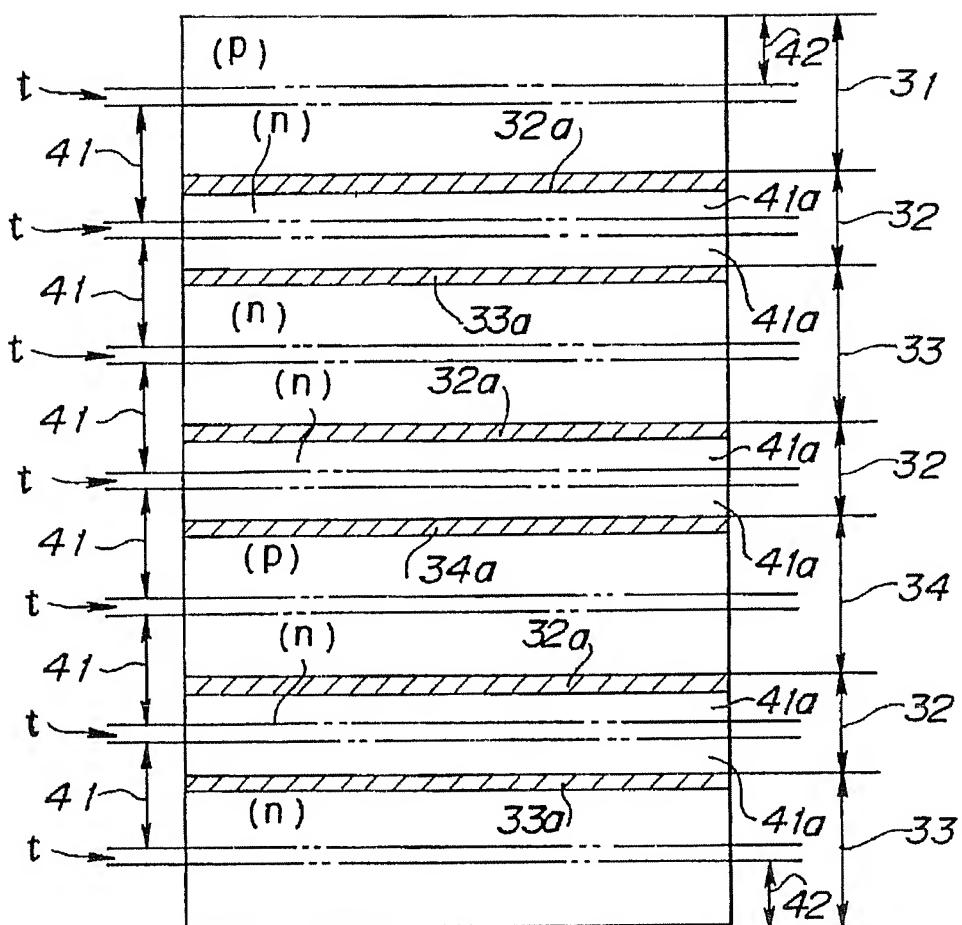


FIG. 8

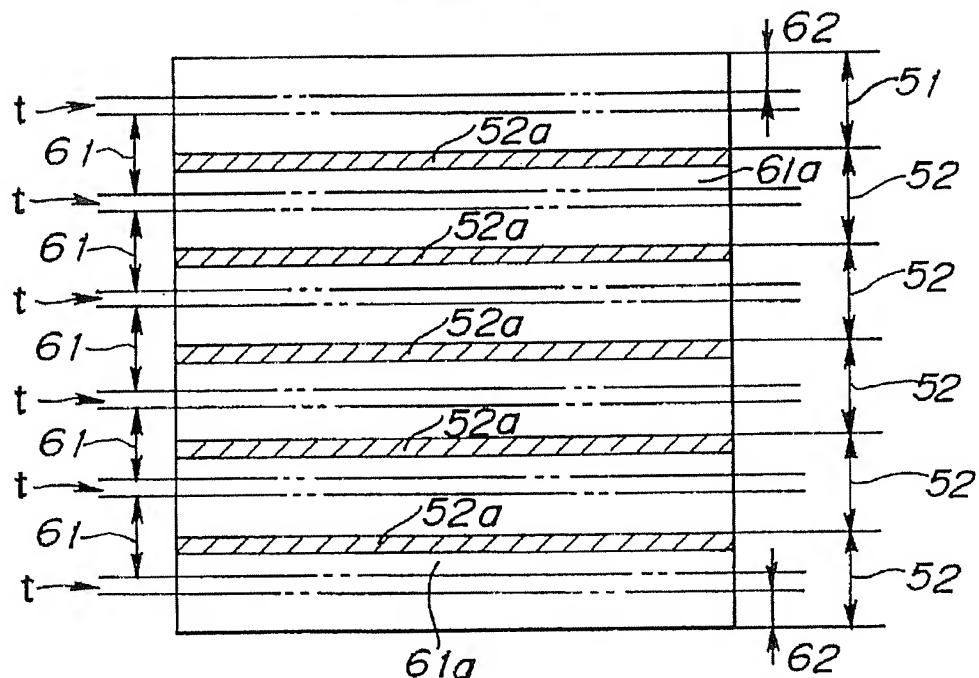


FIG. 9

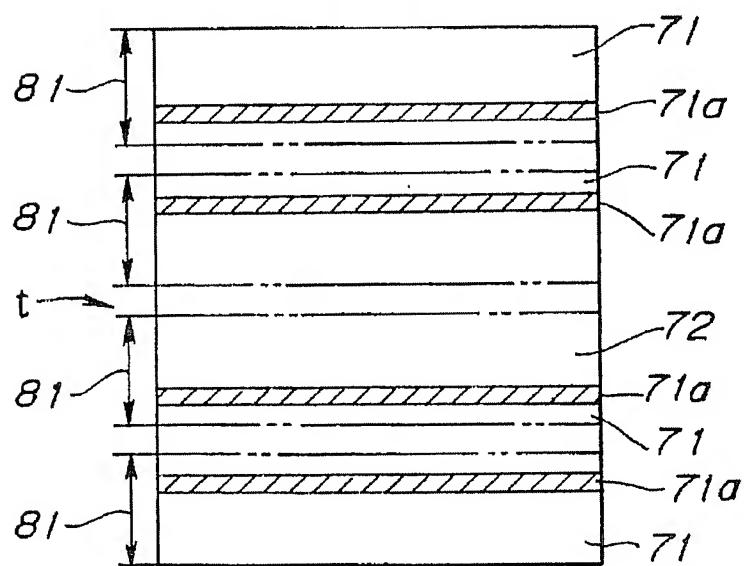


FIG. 10

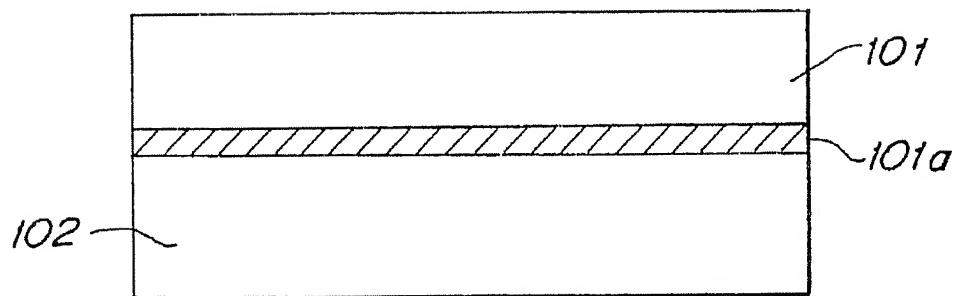
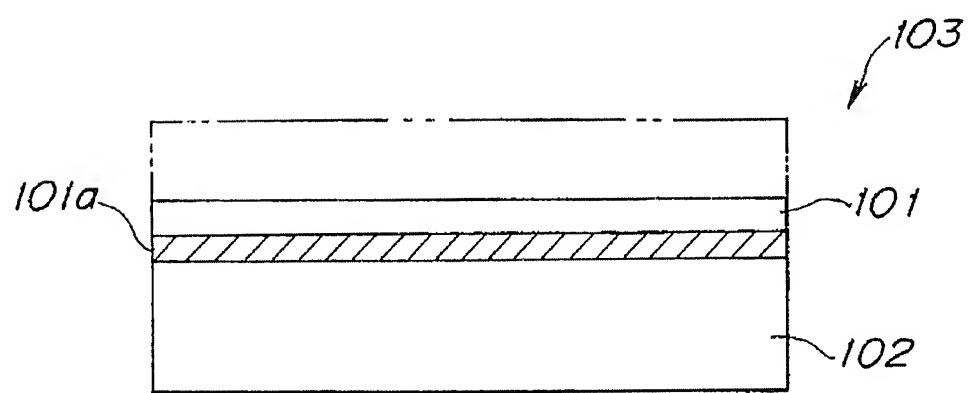


FIG. 11



METHOD FOR PRODUCTION OF SOI SUBSTRATE

This application is a continuation of application Ser. No. 08/127,731, filed Sep. 28, 1993, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method for the production of a silicon-on-insulator (SOI) substrate which is so configured as to have a single crystal silicon layer superposed in the form of a semiconductor single crystal layer on an insulator substrate.

2. Description of the Prior Art

The semiconductor element manufactured with a SOI substrate permits a decrease in the parasitic capacitance of wiring and, therefore, readily allows an increase in the speed of operation and further enjoys easy isolation of elements and precludes the phenomenon of latch-up which would occur in the case of a CMOS. By this reason, the SOI substrates have been recently attracting attention as wafers fit for the manufacture of three-dimensional devices which are capable of diversifying functions, augmenting the operational speed, and exalting the integration.

Heretofore, for the production of the SOI construction by the bonding of wafers, there has been employed the method which comprises directly applying a single crystal silicon wafer 101 having a SiO₂ film 101a formed on one surface thereof (hereinafter referred to as "wafer") as illustrated in FIG. 10 fast to a wafer 102 having no SiO₂ film formed thereon, to make adhered, subsequently heat-treating the adhered wafers, thereby bonding them, and then grinding and polishing the wafer 101 of the bonded wafers thereby converting the wafer 101 into a thin film and consequently giving rise to a SOI substrate 103 as illustrated in FIG. 11.

The method described above is at a disadvantage in entailing difficulty in producing inexpensively the SOI substrate because it requires either of the bonded wafers to be ground and polished until it is decreased to a residual layer thickness in the range of 1 to some tens of μm and consequently suffers from waste of not less than about 90% of the wafer.

SUMMARY OF THE INVENTION

This invention aims to solve the problem mentioned above and, for the sake of this solution, provides a method of manufacture which allows the SOI substrate to be produced at a low cost with a simple process and particularly fits mass-production of SOI substrates.

The first aspect of this invention resides in a method for production of a substrate having a semiconductor single crystal layer formed on an insulator substrate, which is characterized by superposing and bonding at least three single crystal silicon wafers through the medium of a SiO₂ film formed on the surface of each of the 2 wafers and cutting the superposed and bonded wafers along planes perpendicular to the direction of superposition thereof.

The second aspect of this invention resides in a method for production of a SOI substrate, which is characterized by preparing at least three single crystal silicon wafers having surfaces for bonding mirror polished, subjecting at least either of the opposite wafer main faces for bonding to a preparatory thermal oxidizing treatment thereby forming a SiO₂ film thereon, directly piling the surfaces of the plurality of wafers one upon another thereby combining the wafers in

a tightly superposed state, heat-treating the wafers in the combined state in an atmosphere of inert gas or in an oxidizing atmosphere thereby binding the tightly adhering surfaces thereof, cutting the bonded wafers except for the wafer on one terminal side relative to the direction of superposition along planes perpendicular to the direction of superposition, and polishing the freshly cut surfaces of the resultant divided substrates by the etching technique, the planar grinding technique, the mirror polishing technique, or a similar thereby converting the divided substrates each into a thin film.

The third aspect of this invention resides in a method for production of a SOI substrate, which is characterized by preparing one single crystal silicon wafer having the opposite surfaces thereof mirror polished and then thermally oxidizing and thereby causing to form a SiO₂ film thereon, preparing two single crystal silicon wafers having one of the opposite surfaces thereof mirror polished, nipping the one single crystal silicon wafer with the two single crystal silicon wafers thereby forming a tightly superposed pile of wafers, heat-treating the superposed pile of wafers in an atmosphere of inert gas or in an oxidizing atmosphere thereby binding the superposed wafers, subsequently cutting the intervening single crystal silicon wafer in the bonded wafers along planes perpendicular to the direction of superposition, and subjecting the freshly cut surfaces of the divided substrates first to the planar grinding and then to the mirror polishing thereby converting the divided substrates each into a thin film.

The fourth aspect of this invention resides in a method according to any of the above-mentioned aspects of this invention, wherein guide grooves on a cylindrical side of a bonded wafers (or a bonded pile of wafers) for guiding the blade of a cutting tool are formed at the positions at which cuts are to be made in planes perpendicular to the direction of superposition in preparation for said cutting.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and the objects and features thereof other than those set forth above will become apparent when consideration is given to the following detailed description thereof, which makes reference to the accompanying drawings wherein:

FIG. 1 is a cross section depicting Example 1 of this invention, illustrating a bond wafer and a base wafer before their mutual bonding.

FIG. 2 is a cross section depicting Example 1, illustrating the bond wafer and the base wafer after their mutual bonding.

FIG. 3 is a cross section depicting Example 1, illustrating a bonded wafer after they have been cut apart.

FIG. 4 is a cross section depicting Example 1, illustrating SOI substrates obtained by polishing the divided wafers.

FIG. 5 is a cross section illustrating a bonded wafer having formed on the cylindrical side of a bonded wafers a groove for guiding the blade of a cutting tool.

FIG. 6 is an explanatory cross section depicting Example 2 of this invention.

FIG. 7 is an explanatory cross section depicting Example 3 of this invention.

FIG. 8 is an explanatory cross section depicting Example 4 of this invention.

FIG. 9 is an explanatory cross section depicting Example 5 of this invention.

FIG. 10 is a cross section depicting the conventional example, illustrating the construction of a bonded wafer.

FIG. 11 is a cross section depicting the conventional example, illustrating a SOI substrate.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

When a SOI substrate is manufactured by combining five (n) wafers in accordance with the invention, for example, four wafers of the same thickness having a SiO₂ film formed on one of the opposite surfaces thereof and one wafer of a larger thickness (having no SiO₂ film formed thereon) are bonded as illustrated in an example to be cited hereafter (FIG. 9) and the three intervening wafers are cut in the prescribed portions to obtain four (n-1) SOI substrates of the same specification simultaneously.

For this invention, it is extremely important to fix the thickness of each of the wafers before they are superposed and bonded. As respects the individual SOI substrates obtained by the cutting mentioned above, the freshly cut surfaces thereof are ground and then mirror polished, for example. The loss of material of the wafers can be conspicuously decreased by setting the amounts of initial stock involved during the aforementioned cutting and those of stock during the grinding and the mirror polishing at the minimum technically attainable levels.

In the method of the second aspect of this invention, the bond of one wafer to another wafer is produced between the SiO₂ film surface of the former wafer and the surface (of Si) of the latter wafer. Though the mechanism of this bonding has not been exactly elucidated, it may be logically explained by a postulate that the hydrophilic OH⁻ groups present on the wafer surfaces give rise to a hydrogen bond between silicon atoms on the two wafers, one silicon atom each on the wafers, and induce tight mutual bonding of these two wafers and the heat treatment subsequently accelerates a dehydration-condensation reaction on the hydroxyl radicals and brings about more perfect bonding of the wafers.

The method of the third aspect of this invention permits production of two SOI substrates from three wafers as the minimum allowable unit of fabrication. By restraining the amounts of initial stock during the cutting and the amounts of stock during the planar grinding and the mirror polishing so as to decrease the loss of wafers, the ratio of effective utility of raw material wafers can be improved to a great extent.

From the two component single crystal silicon wafers before the superposing and bonding, the single crystal silicon wafer on which the SiO₂ film is formed by the thermal oxidation treatment, is selected and utilized for single crystal silicon layer for the formation of a semiconductor element of the SOI substrate. This particular selection is accounted for by the following two reasons.

The first reason is that the preparatory thermal oxidizing treatment given to the single crystal silicon layer which is destined to be utilized for the formation of a semiconductor element is effective in preventing this single crystal silicon layer from another pollution at least in the various subsequent steps in which the step of heat treatment for the bonding of superposed wafer layers is important. The second reason is that the control on physicochemical properties of the interface between the single crystal silicon layer and the SiO₂ film to be utilized as a layer for the formation of a semiconductor element can be carried out infallibly when this single crystal silicon layer for the formation of the semiconductor element atomically contacts the SiO₂ film produced by the thermal oxidizing treatment mentioned above, whereas the possibility of pollution of the layer for

the formation of the semiconductor element dealt with in the first reason above cannot be precluded and the control of the physicochemical qualities of the portion of bonding and the uniformity of that quality is attained only with difficulty when the layer utilized for the formation of the semiconductor element directly contacts the SiO₂ film produced on the opposing bonding surface mentioned above.

Now, the present invention will be described more specifically below with reference to the working examples 10 illustrated in the drawings.

EXAMPLE 1

First three single crystal wafers which are identical in specification inclusive of a dimensional description are prepared. As illustrated in FIG. 1, one of the single crystal wafers has both the opposite surfaces thereof and the remaining two single crystal wafers have either of the opposite surfaces thereof mirror polished. These mirror polished surfaces are designated as bond surfaces 1a and 2a. 15 These bond surfaces are desired to have a roughness, Ra, of not more than 0.4 nm. If this surface roughness exceeds 0.4 nm, the bonding of the single crystal wafers cannot be obtained and, even when the bonding is obtained somehow or other, unbonded regions called "voids" occur in the 20 interface of bonding and the produced SOI layer (layer for the formation of a semiconductor element) fails to constitute a uniform film.

The mirror polishing in this case is carried out by the well-known mechanochemical polishing technique.

30 The wafers which have been given the mirror polishing are washed with a detergent selected from among NH₄OH/H₂O₂, H₂SO₄/H₂O₂, HCl/H₂O₂, HF, and organic solvents for the purpose of removing therefrom the adhesive agent used for applying the wafers to a carrier plate at the time of 35 polishing, the abrasive used for the polishing, and particles arising from the polishing, for example.

The wafer which has had both the opposite surfaces thereof mirror polished and then has been washed is to be used as a bond wafer 1 and the two wafers which have had one of the opposite surfaces thereof mirror polished and then have been washed are to be used as base wafers 2 destined to fulfill the part of a base member.

40 There are times when such impurities as C, H, F, and Cl which originate in the detergent mentioned above are adhering to the bond surfaces 1a and 2a of the bond wafer 1 and the base wafers 2 after the washing. In these impurities, organic impurities including carbon can be decomposed and removed by the ozone which occurs when the bond surfaces 45 are exposed (not shown) to an ultraviolet light in an atmosphere of oxygen.

Then, the bond wafer 1 is subjected to a thermal oxidizing treatment in an oxidizing atmosphere to form a SiO₂ film 3 on the whole surface of the bond wafer 1 as illustrated in FIG. 1. The temperature of the thermal oxidizing treatment is desired to be in the range of 800° C. to 1,200° C. and the thickness of this film is desired to be in the approximate range of 0.1 μm to 3 μm.

Now, the bond surfaces 2a, 2a of the base wafers 2 are 50 superposed on and attached tightly to bond surfaces 3a, 3a of the SiO₂ film 3 which have been formed on the opposite main surfaces of the bond wafer 1. The superposed wafers are then heat-treated in an atmosphere containing N₂ or O₂ to obtain a bonded wafer 4 as illustrated in FIG. 2. The 55 temperature of this heat treatment is required to exceed 800° C. and the duration of the heat treatment to fall in the approximate range of one to two hours.

The bonding of the wafers 1 and 2 in this case must be carried out as soon as possible after the formation of the SiO₂ film 3. If this requirement is not fulfilled, the possibility may arise that the minute dust particles floating in the ambient air will adhere fast to the bond surfaces to the extent of impairing the cleanliness thereof, giving rise to voids in the interface of bonding, unduly degrading the strength of bonding, and even preventing the production of a SOI layer of uniform quality.

The bonded wafer 4 is then cooled and subsequently cut with a diamond blade 11 in the direction along a plane perpendicular to the direction of thickness of the bond wafer 1, namely in the direction parallel to the bond surface as illustrated in FIG. 2.

The cutting produces two SOI substrates 5 and 6 which have a bond wafer 1' deposited thereon are formed severally on the base wafers 2 as illustrated in FIG. 3.

The surfaces (the SiO₂ film 3 side surface) of the bond wafers 1' deposited one each on the two SOI substrates 5 and 6 are ground and polished until the residual wall thickness of the bond wafer 1' reaches 6 µm, for example. They are further subjected to finish polishing to reduce the bond wafers 1' to a thin film 3 µm in thickness, for example. As a result, two SOI substrates 7 and 8 are obtained as finished products which are provided on the surface thereof with an element-forming layer 1" as illustrated in FIG. 4.

Now, the method for cutting the bonded wafer 4 (FIG. 2) and the results of a relevant test will be described below.

Wafers having different diameters of 4, 5, 6, and 8 inches and an equal wall thickness of about 1,000 µm were prepared as bond wafers 1 and base wafers 2 and a plurality of bonded wafers 4 of such a construction as illustrated in FIG. 2 were manufactured with the wafers. The bonded wafers 4 were cut with a diamond blade having a varying blade thickness indicated in Table 1 given below. The amounts of stock removed from the bond wafers by cutting, grinding and polishing were as shown in the column titled "Total" in Table 1. The bond wafers used in the present experiment had a wall thickness of about 1,000 µm. The fact that such an element-forming layer 1" as illustrated in FIG. 4 has a wall thickness of not more than 10 µm justifies a conclusion that the bond wafer before cutting is required only to have a thickness which is not more than the total indicated in Table 1 plus 20 µm.

TABLE 1

| Conditions of cutting | Diameter (inch) of silicon wafer | 4 | 5 | 6 | 8 |
|---|---|------|------|------|------|
| Feed speed for cutting (mm/min.) | 65 | 60 | 50 | 40 | |
| Thickness of blade (µm) | 300 | 300 | 300 | 300 | |
| Amount of stock removed by cutting, polishing, etc. | Amount of stock removed during cutting (A): (µm) | ca. | ca. | ca. | ca. |
| | Thickness of layer strained by fabrication during cutting (µm) | ca. | ca. | ca. | ca. |
| | Amount of stock removed by grinding and polishing after cutting (B): (µm) | 15 | 19 | 20 | 22 |
| | Total, A + 2B (µm) | 30- | 30- | 30- | 30- |
| | | 50 | 50 | 60 | 60 |
| | | ca. | ca. | ca. | ca. |
| | | 380- | 380- | 380- | 460- |
| | | 420 | 420 | 440 | 520 |

Here, the procedure for cutting a wafer with the diamond blade mentioned above will be described below. A cutter device (not shown) comprises a retaining disc having one

terminal surface thereof adapted as a wafer-fixing surface, a plurality of suction discs capable of vacuum aspiration, and the diamond blade attached to the shaft of a drive motor. In this case, the wafer-fixing surface of the retaining disc is opposed to the suction discs, and the retaining disc is adapted to be moved with fine adjustment in the direction vertical to the wafer-fixing surface and in the direction toward the suction discs by means of an index pitch mechanism provided in the retaining disc. The suction discs are adapted to be moved toward and away from the wafer surface by means of a drive arm, and the blade is adapted to have the blade surface reciprocated in the direction parallel to the wafer-fixing surface. The cutting of the bonded wafer 4 is prepared by fixing this bond wafer on the wafer-fixing surface, and fixing the outer opposite surfaces at one end of the bonded wafer 4 (the two surfaces farthest from the diamond blade) with holding plates (not shown) made of epoxy resin, a material having no possibility of scratching a wafer, and endowed with a clamping function. Then, the cutting is initiated after causing the retaining disc to be moved as finely adjusted thereby enabling the edge of the diamond blade to be opposed exactly to the outer surface of the bond wafer 1, further advancing the suction disc with the drive arm so as to exert a suction force in the direction of peeling the bonded wafer 4 from the retaining disc on the bonded wafer 4, then advancing the blade parallelly to the bond wafer 1, and pressing the blade against the outer surface of the wafer. In this case, the aforementioned holding plates are simultaneously cut with the wafer. Since one surface of the bonded wafer 4 is under the influence of the suction force of the suction disc and the other surface is fixed to the retaining disc, the cutting proceeds while, of the divided bond wafers being formed by the cutting, that on the suction disc side is separated from that on the retaining disc side. After the cutting is completed, the two divided bonded wafers are perfectly separated from each other by the action of the drive arm. In the operation described above, it is important that the vibration of the motor shaft and other similar adverse phenomena should be restrained to the fullest possible extent.

When a guide groove 9 for guiding the edge of the diamond blade is provided at the position of cutting of the bond wafer 1 as illustrated in FIG. 5 in preparation for the cutting of the bond wafer 1 along a plane perpendicular to the direction of thickness of the bond wafer 1, the cutting can be infallibly attained with highly satisfactory dimensional accuracy because the edge of the diamond blade is not suffered to vibrate.

The thickness of the edge of the diamond blade is governed by the diameter of the bond wafer to be cut, the feed rate of cutting, and a similar. This thickness must be decreased in proportion as the diameter of the bond wafer decreases and it must be increased in proportion as the diameter increases. Depending on the size of this diameter, the thickness is selected in the range of 250 µm to 400 µm with due respect to the feed rate of cutting and the balance between the strength of the blade and the accuracy of cutting. Thus, the initial stock for cutting which embraces the influence of the change of blade thickness by the lateral vibration of the blade in the process of cutting is the sum of the thickness of blade plus 20 µm, i.e. a value in the range of 270 µm to 420 µm.

The SOI substrate is basically composed of a supporting layer indicated as a base wafer 2, an insulating layer (SiO₂ film 3) made of SiO₂, and an element-forming layer 1" constituting itself the uppermost layer. The amount of stock to be removed by the etching to be performed during the

formation of the element-forming layer 1" and the grinding, polishing, etc. is roughly 30 μm to 60 μm . The reason for this particular amount of stock is that even when the cutting with the diamond blade forms in the opposed wall surfaces of a cut in the wafer a layer of strain by fabrication about 15 to 22 μm in thickness, this layer of strain by fabrication can be completely removed by selecting the amount of stock for the cutting in the range between 30 μm and 60 μm .

The thickness of the bond wafer 1 destined to be cut must be set with due respect to the amount of stock removed during the process of cutting, the thickness of the layer of strain by fabrication desired to be removed, the amounts of stock removed by etching, grinding, and polishing, and the thickness of the element-forming layer in the finally produced SOI substrate.

Desirably in the SOI substrate, the thickness of the element-forming layer is in the range of 0.01 μm to 100 μm , that of the SiO_2 insulating layer in the range of 0.1 μm to 3.0 μm , and that of the base wafer 2 in the range of 300 μm to 1,000 μm .

As respects the element-forming layer, a thickness of not more than 100 μm suffices for the formation of an element. If this thickness exceeds the upper limit mentioned above, the excess merely adds to the cost of this layer. Conversely, if the thickness is less than 0.01 μm , the fabrication is not easily attained even with a highly advanced technique.

The thickness of the SiO_2 insulating layer is only required to exceed 0.1 μm for ensuring ample manifestation of the dielectric strength aimed at. If this thickness exceeds 3.0 μm , the excess brings about no advantage.

The thickness of the supporting layer has a range of itself for retaining proper mechanical strength, depending on the diameter of wafer. In consideration of wafers which measure 3 to 8 inches in diameter, the thickness of substrate is proper in the range of 300 μm to 1,000 μm .

EXAMPLE 2

FIG. 6 depicts an example in which two bonded wafers are obtained from three single crystal silicon wafers 21 having an equal specification and having a SiO_2 film 21a formed on the whole surface thereof. In this case, two SOI substrates which are identical in specification are manufactured by bonding the three silicon wafers and then subjecting the intermediate one of the three superposed silicon wafers 21 to the cutting and to the subsequent mirror polishing in faithful accordance with the procedure of Example 1.

EXAMPLE 3

FIG. 7 depicts an example in which single crystal silicon wafers differing in form of electroconductivity and thickness are superposed and bonded.

A total of seven silicon wafers, i.e. one p-type silicon wafer 31, three n-type silicon wafers 32 having a SiO_2 film 32a formed on one of the opposite surfaces thereof, two n-type silicon wafers 33 having a SiO_2 film 33a formed on one of the opposite surfaces thereof and having a thickness equal to that of the wafer 31 and roughly twice as large as that of the wafers 32, and one p-type silicon wafer 34 having a SiO_2 film formed on one of the opposite surfaces thereof and having a thickness equal to that of the silicon wafer 31, are prepared. They are superposed and bonded as illustrated in FIG. 7. In all the silicon wafers, the portions of a thickness indicated by two-dot chain lines are subjected to cutting and then six bonded wafers are subjected to mirror polishing. Thus, six SOI substrates 41 (unpolished SOI substrates

to be exact) having an equal overall thickness and different electrical properties are simultaneously manufactured. With reference to FIG. 7, p and n stand for types of electroconductivity. 41a stands for an element-forming layer, and 42 stands for a portion to be discarded by cutting. In this case, the thickness of the portions 42 to be discarded can be minimized by thinning the wafers 31 and 33 forming respectively the uppermost and lowermost layers of the bonded wafer to the fullest possible extent.

For the operation of cutting mentioned above, the same cutter device as used in cutting the bonded wafer 4 mentioned above can be used.

In this case, the portions indicated by the two-dot chain lines in FIG. 7 can be wholly cut conveniently by cutting into the wafer nearest to the suction disc in a prescribed thickness, separating the cut portions from the wafers on the retaining disc side, moving the retaining disc by a prescribed distance toward the suction disc side by the index pitch mechanism, performing the cutting operation, and then repeating this procedure.

EXAMPLE 4

FIG. 8 depicts a case of simultaneous manufacture of five SOI substrates 61 identical in specification by preparing six silicon wafers 51 identical in specification inclusive of type of electroconductivity and resistivity, treating five of the six silicon wafers 51 thereby forming a SiO_2 film 51a on one of the opposite surfaces thereof and producing five silicon wafers 52 each provided with the SiO_2 film, superposing and bonding the six silicon wafers as illustrated in FIG. 8, and inserting cuts in the resultant bond wafer in the same manner as in Example 3. In the diagram of FIG. 8, 61a stands for an element-forming layer and 62 for a portion to be discarded by the cutting.

EXAMPLE 5

FIG. 9 depicts a case of simultaneous manufacture of four SOI substrates 81 identical in specification by preparing four silicon wafers 71 having a SiO_2 film 71a formed on one of the opposite surfaces thereof and one silicon wafer 72 having a thickness twice as large as that of the silicon wafer 71, bonding the silicon wafers, and cutting the bonded silicon wafers in the same manner as described above.

In this case, the loss of wafer can be reduced substantially to nil by suitably setting the thickness of the silicon wafer 72.

It is clearly noted from the description given above that the method of manufacture of a SOI substrate by the first aspect of this invention permits fabricated substrates to be produced with a high operational efficiency without entailing any waste of raw material wafer.

Especially by the particular embodiment of the second aspect of this invention, n-1 SOI substrates can be obtained from n wafers.

In this case, n-1 SOI substrates can be conveniently manufactured by causing a bulk of bonded wafers obtained by superposing and bonding n wafers to be cut with the aforementioned cutter device which is provided with a retaining disc, suction discs, and an index pitch mechanism. Thus, the method under discussion excels in the ability to mass-produce SOI substrates.

Then, the loss of raw material can be minimized by setting the thickness of each raw material wafer at the irreducible minimum of demand.

The methods of the second and the third aspect of this invention enable a plurality of wafers to be bonded by a

simple process of heat-treating the wafers in the superposed state without calling for use of any adhesive agent.

The method of the third aspect of this invention obtains SOI substrates by preparing at least two ordinary mirror polished wafers and a wafer having a SiO₂ film formed on both surfaces thereof, directly superposing the former wafers one each on the opposite surfaces of the latter wafer, and bonding opposed Si surfaces and SiO₂ film surfaces thereby forming a three-layer bonded wafer, and thereafter cutting the bonded wafer in the portion of the latter wafer. Thus, the process of manufacture and the apparatus of manufacture involved in this case are both convenient. Particularly, the loss of raw material can be decreased conspicuously because this method permits production of two SOI substrates from three raw material wafers.

Comparison of this method with the conventional method described above reveals that, on calculation, the present method obtains five SOI substrates and the conventional method three SOI substrates respectively from six wafers. This method, therefore, allows the cost of material to be decreased to $\frac{2}{3}$ of that which is required by the conventional method and, therefore, promises a notable cut of the cost of SOI substrates.

Further, since the conversion of one surface side of the bonded wafer into a thin film is accomplished by grinding or polishing, the time spent for this conversion can be shortened and the labor required therefor can be notably decreased.

In accordance with the method of the fourth aspect of this invention, since the portion destined to be cut is provided with a groove for guiding the blade of the cutting tool in advance of the cutting work, the cutting can be infallibly attained with high dimensional accuracy without entailing such adverse phenomena as the vibration of the blade.

While there have been shown and described preferred embodiments of this invention, it is to be distinctly understood that the present invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the claims given below.

What is claimed is:

1. A method for the production of a substrate having semiconductor single crystal layers formed on an insulating substrate, comprising the steps of:

preparing at least three single crystal silicon wafers having surfaces for bonding mirror polished; 45
subjecting either one of the opposite wafer surfaces for bonding to a preparatory thermal oxidizing treatment thereby forming a SiO₂ film thereon;

directly piling the surfaces of said wafers one upon another thereby combining said wafers in a superposed state;

heat-treating said wafers in said superposed state in an atmosphere of inert gas or in an oxidizing atmosphere thereby binding the adhering surfaces thereof; 5
cutting the bonded wafers except for the wafer on one terminal side relative to the direction of superposition along planes perpendicular to said direction of superposition;

polishing the cut surfaces of the resultant divided substrates thereby converting said divided substrates each into a thin film; and

wherein guide grooves for guiding the blade of a cutting tool in advance of cutting work are formed at the positions at which cuts are to be made in planes perpendicular to the direction of superposition in preparation for said cutting.

2. A method for the production of a substrate having semiconductor single crystal layers formed on an insulating substrate, comprising the steps of:

preparing one single crystal silicon wafer having both surfaces thereof mirror polished and then thermally oxidizing and thereby causing a SiO₂ film to form thereon;

preparing two single crystal silicon wafers having one of the surfaces thereof mirror polished;

superposing said one single crystal silicon wafer between said two single crystal silicon wafers thereby forming a superposed pile of wafers;

heat-treating said superposed pile of wafers in an atmosphere of inert gas or in an oxidizing atmosphere thereby binding the superposed wafers;

subsequently cutting said one single crystal silicon wafer along planes perpendicular to the direction of superposition;

subjecting the cut surfaces of the divided substrates to the planar grinding and then the mirror polishing thereby converting said divided substrates each into a thin film; and

wherein guide grooves for guiding the blade of a cutting tool in advance of cutting work are formed at the positions at which cuts are to be made in planes perpendicular to the direction of superposition in preparation for said cutting.

* * * * *

EXHIBIT C

FULL TEXT OF CASES (USPQ FIRST SERIES)

In re Lalu and Foulletier

(CA FC)
223 USPQ 1257
Decided Nov. 2, 1984
No. 83-1358
U.S. Court of Appeals Federal Circuit

Headnotes**PATENTS****1. Patentability - Invention - Specific cases - Chemical (§ 51.5093)**

Mere fact that reference cites compounds, structurally similar to applicants' claimed compounds, that can be used as intermediates in production of reference's claimed compounds does not provide adequate motivation for one of ordinary skill in art to stop reference's synthesis and investigate intermediate compounds with expectation of arriving at applicants' claimed compounds that have different uses, rendering structural obviousness rejection unsupported.

Particular patents - Sulfonic Acids

Lalu and Foulletier, New Polyfluorinated Sulfonic Acids and their Derivatives, rejection of claims 13-22 reversed.

Case History and Disposition:

Page 1257

**Appeal from Patent and Trademark Office Board of Appeals.
Application for patent of Jean Pierre Lalu, and Louis Foulletier,**

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Serial No. 966,508, filed Dec. 4, 1978. From decision rejecting claims 13-22, applicants appeal. Reversed.

Attorneys:

Brian Poissant, New York, N.Y. (Clyde C. Metzger, New York, N.Y., of counsel) for appellant.

Joseph F. Nakamura, Solicitor, Jere W. Sears, Deputy Solicitor, and Henry W. Tarring, II, Associate Solicitor, for Patent and Trademark Office.

Judge:

Before Baldwin and Kashiwa, Circuit Judges, and Cowen, Senior Circuit Judge.

Opinion Text

Opinion By:

Baldwin, Circuit Judge.

This appeal is from a decision of the United States Patent and Trademark Office Board of Appeals (board) affirming the rejection under 35 U.S.C. §103 of claims 13-22, all of the claims of appellants' application Serial No. 966,508, filed December 4, 1978, for "New Polyfluorinated Sulphonic Acids and Their Derivatives." We reverse.

The Invention

The invention relates to perfluoroalkyl sulfonyl chlorides and bromides having the formula:

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wherein the perfluoroalkyl group

Graphic material consisting of a chemical formula or diagram set at this point is not available. See text in hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323. is defined by n being a number between 1 and 20, Z is a chlorine or bromine atom, and the bridging group (CH_2)_b is defined by b being a number between 2 and 20.

The claimed compounds are useful in the textile, leather, and paper industries. The compounds have utility as corrosion inhibiting agents, surface active agents, and leveling agents, and therefore can be incorporated into waxes, greases, varnishes, and paints to improve the spreading out and leveling of such viscous products.

Claim 13, the only independent claim on appeal, is illustrative:

13. A product having the formula

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wherein

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represents a straight or branched perfluorinated hydrocarbon chain, n is a number between 1 and 20, b is a number between 2 and 20 and Z is a chlorine or bromine atom.

Claims 14-22 depend from claim 13 and further limit the parameters n, b, and Z which define the length of the perfluoroalkyl group, the length of the bridging group, and the nature of the Z halide group, i.e., a chlorine or bromine atom.

The Prior Art

The sole reference relied upon by the board is United States Patent No. 3,130,221 issued April 21, 1964 to Oesterling. Oesterling discloses 1,1-dihydroperfluoroalkyl sulfonic acids having the formula:

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wherein

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is a lower perfluoroalkyl group and the bridging group is a methylene (CH₂) group.

According to Oesterling, "The compounds of this invention include the 1,1-dihydroperfluoroalkyl acids containing from two to five carbon atoms; i.e., from one to four carbon atoms in the * * * [perfluoroalkyl] portion of the molecule." These compounds are strong acids and are used in reactions such as base neutralization, alkylation catalysis, and metal cleaning. Additionally, the compounds are useful as high energy fuels such as liquid rocket propellants because of their relatively high thermal stability. Of the group of acids disclosed by Oesterling, "the preferred compound for use as a high energy fuel is 1,1-dihydroperfluoroethylsulfonic acid [CF₃CH₂SO₃H]. As the number of carbon

Page 1258

atoms in the molecule increases, the thermal stability decreases and compounds containing above five carbon atoms are of little value as a fuel."

The claimed sulfonic acids are prepared in the reference by chlorination of the corresponding bis (1,1-dihydroperfluoroalkyl) disulfides to form the corresponding 1,1-dihydroperfluoroalkyl sulfonyl chlorides, which are then hydrolyzed to produce the product 1,1-dihydroperfluoroalkyl sulfonic acids. The intermediate sulfonyl chlorides which are used to prepare the final product acids have the formula:

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wherein

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is also a lower perfluoroalkyl group and the bridging group is a methylene (CH_2) group. Oesterling teaches that the hydrolysis may be carried out without isolation of the intermediate sulfonyl chloride, but it is preferable to hydrolyze isolated sulfonyl chloride in order to obtain a purer sulfonic acid product.

The Rejection

The examiner rejected the claims based on structural obviousness because Oesterling teaches homologous compounds. The examiner said, "Oesterling discloses only one method of preparing the sulfonic acids which *requires* the use of the halide intermediate. One motivated to prepare the homologous acids would similarly be motivated to prepare the homologous acids halides." (emphasis in original).

The board, in affirming the examiner's rejection, said the close structural similarity between the reference sulfonyl chloride compounds and the claimed compounds was sufficient to raise the presumption of obviousness. The board said further:

The fact that the reference teaches that the sulfonyl chloride compounds are useful as an intermediate or a starting compound for the production of a corresponding sulfonic acid as opposed to the appellants' disclosure that the claimed compounds have other utilities does not by itself rebut the *prima facie* case of obviousness made out by the Examiner. * * *

The case of *In re Stemniski*, 58 CCPA 1410, 444 F.2d 581, 170 USPQ 343 (1971), is distinguishable since here Oesterling discloses a utility (a starting material for making an acid) for the pertinent sulfonyl chlorides, whereas in *Stemniski* the reference disclosed no utility for the relevant compound. In view of the unequivocal identification and isolation of the sulfonyl chloride by Oesterling and the specific utility taught for the compound, a starting material for the preparation of a useful acid, the portions of the court's decision in *In re Gyurik*, 596 F.2d 1012, 201 USPQ 552 (CCPA 1979), relied upon by the appellants are not considered to dictate reversal of the Examiner's holding.

Opinion

Appellants argue that the acid taught by Oesterling is limited to a maximum of five carbon atoms and, therefore, there would be no motivation for one of ordinary skill to prepare an acid, or its predecessor sulfonyl chloride containing more than five carbon atoms. Accordingly, appellants contend that since their compounds may contain up to forty carbon atoms, they are not structurally similar to the Oesterling intermediate sulfonyl chlorides. We disagree with appellants' contentions because the Oesterling teachings regarding the five carbon atom limitation are related only to the use of the product acid as a high energy fuel. Oesterling discloses other uses for the disclosed sulfonic acids, such as in base neutralization, alkylation catalysis, and metal cleaning, to which the teachings of a five carbon atom limitation do not necessarily apply. Moreover, even if the compounds disclosed by Oesterling are limited to compounds containing two to five carbon atoms, the appellants' compounds contain as few as three carbon atoms.

We are, however, persuaded that the board erred in its conclusion of *prima facie* obviousness.

In determining whether a case of *prima facie* obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modification. **In re Copyright 2006, The Bureau of National Affairs, Inc. Reproduction or redistribution, in whole or in part, and in any form, without express written permission, is prohibited except as permitted by the BNA Copyright Policy. http://www.bna.com/corp/index.html#V**

Taborsky, 502 F.2d 775, 780, 183 USPQ 50, 55 (CCPA 1974). The prior art must provide one of ordinary skill in the art the motivation to make the proposed molecular modifications needed to arrive at the claimed compound. In re Stemniski, 444 F.2d 581, 586, 170 USPQ 343, 347 (CCPA 1971), Taborsky, 502 F.2d at 781, 183 USPQ at 55, In re Murch, 464 F.2d 1051, 175 USPQ 89 (CCPA 1972), In re Fay, 347 F.2d 597, 146 USPQ 47 (CCPA 1965).

In Stemniski, the claimed compounds were rejected over structurally closely related compounds disclosed in prior art references. The references did not disclose or suggest any usefulness or significant properties, whereas the applicant disclosed a use for the claimed compounds in his application.

In such a case the court reasoned that the requisite motivation to make the claimed

Page 1259

compounds would not be present. The court doubted whether a *prima facie* case of obviousness existed:

How can there be obviousness of structure, or particularly of the subject matter as a whole, when no apparent purpose or result is to be achieved, no reason or motivation to be satisfied, upon modifying the reference compounds structure? Where the prior art reference neither discloses nor suggests a utility for certain described compounds, why should it be said that a reference makes obvious to one to ordinary skill in the art an isomer, homolog or analog of related structure, when that mythical, but intensely practical, person knows of no "practical" reason to make the reference compounds, much less any structurally related compounds? 444 F.2d at 586, 170 USPQ at 347.

Appellants argue that since several utilities were disclosed for the compounds claimed, and Oesterling teaches no significant properties or utility for the disclosed sulfonyl chlorides except as intermediates in the formation of the product sulfonic acids, the rejection of the instant claims is not proper in view of Stemniski. The Patent and Trademark Office (PTO) contends that Stemniski is satisfied and the rejection is proper because Oesterling discloses that the sulfonyl chlorides are used as intermediates or starting materials for producing useful acids.

The PTO further argues that the disclosed utility for the Oesterling sulfonyl chlorides as an intermediate for producing useful acids is a usefulness conforming with statutory guidelines, but cites cases for support which are actually inapposite: Reiners v. Mehlretter, 236 F.2d 418, 421-22, 111 USPQ 97, 100 (CCPA 1956), an interference in which structural obviousness was not an issue, and In re Kirk, 376 F.2d 936, 943-44, 153 USPQ 48, 54 (CCPA 1967), a case dealing with appellant's disclosure of "how to use" the claimed compounds under 35 U.S.C. §112.

Other cases involving obviousness have dealt with the role of intermediates. In In re Gyurik, 596 F.2d 1012, 201 USPQ 552 (CCPA 1979), the claimed thio compounds were rejected as *prima facie* obvious over a reference which generally disclosed such thio compounds as intermediates in the preparation of the corresponding sulfonyl compounds having the same general properties as those of the claimed compounds. The issue framed by the court was based solely upon the status of the claimed compounds as intermediates

in the production of end products specifically named in the prior art.

In reversing the obviousness rejection the court said:

An element in determining obviousness of a new chemical compound is the motivation of one having ordinary skill in the art to make it. That motivation is not abstract, but practical, and is always related to the properties or uses one skilled in the art would expect the compound to have, if made. In re Stemniski * * * The present obviousness rejection cannot stand without some basis in the expected properties of the claimed compounds.

In obviousness rejections based on close similarity in chemical structure, the necessary motivation to make a claimed compound, and thus the *prima facie* case of obviousness, rises from the expectation that compounds similar in structure will have similar properties. * * * No common-properties presumption rises from the mere occurrence of a claimed compound at an intermediate point in a conventional reaction yielding a specifically named prior art compound. That an intermediate/end-product relationship exists between a claimed compound and a prior art compound does not *alone* create a common-properties presumption. Absent that presumption or other evidence of motivation, it cannot be said that it would have been obvious to stop the process for synthesizing the disclosed end product and isolate the claimed intermediate.¹ [Citations omitted.]

Id. at 1018, 201 USPQ at 557-8.

The court explained footnote 14 of Gyurik in *In re Magerlein*, 602 F.2d 366, 373 n.15, 202 USPQ 473, 479 n.15 (CCPA 1979):

Our recent statement * * * should not be read out of context as suggesting that the capacity to react to produce another compound is not, *ipso facto*, a property. The statement is merely a recognition that *there is no common-properties presumption or evidence of motivation to make the intermediate from the mere fact that an intermediate is in the chain of production of another compound.* [Emphasis added.]

Although Gyurik was not a case of obviousness based on structural similarity, and the facts of both Gyurik and Magerlein are different from those here, the dicta in those cases is helpful as a guide.

The PTO places great emphasis on the label "useful," contending that because the Oesterling final product is "useful," the intermediate sulfonyl chlorides are also "useful."

Page 1260

That there is no common-properties presumption accorded to an intermediate and the end product of the reaction involving that intermediate necessarily means that there is no presumption that an intermediate's utility would be the same as that of the end product. Even if an unspecified "usefulness" or utility were all Stemniski requires, such utility could not be imputed from the fact that the Oesterling final product is "useful." The use of such labels, however, is meaningless because we always look to "the subject matter as a whole" in determining whether the subject matter "would have been obvious at the time the invention was made." Further, a relevant property of a compound cannot be ignored in the determination of non-obviousness. *In re Papesch*, 315 F.2d 381, 391, 137 USPQ

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43, 51 (CCPA 1963).

Ultimately our analysis of the obviousness or nonobviousness of appellants' claimed compounds requires inquiry as to whether there is anything in the Oesterling reference which would suggest the expected properties of the claimed compounds or whether Oesterling discloses any utility for the intermediate sulfonyl chlorides which would support an expectation that the claimed compounds would have similar properties.

[1] There is no disclosure that the Oesterling compounds would have any properties in common with those of appellants' compounds, as those properties of the former relate to the use of the compounds for base neutralization, catalysis, metal cleaning, and fuel. The mere fact that Oesterling's sulfonyl chlorides can be used as intermediates in the production of the corresponding sulfonic acids does not provide adequate motivation for one of ordinary skill in the art to stop the Oesterling synthesis and investigate the intermediate sulfonyl chlorides with an expectation of arriving at appellants' claimed sulfonyl halides for use as corrosion inhibiting agents, surface active agents, or leveling agents.

Oesterling does not teach the isolation and investigation of the intermediate sulfonyl chlorides, but rather discloses, as an optional step, the isolation and purification of the intermediate to obtain a purer sulfonic acid end product. The isolation and subsequent use of the intermediate sulfonyl chlorides in the production of the corresponding useful sulfonic acids is not motivation sufficient to support the structural obviousness rejection. The board has therefore failed to properly establish that the claimed compounds would have been *prima facie* obvious in view of Oesterling.

The decision of the board affirming the rejection of claims 13-22 is *reversed*.

Footnotes

Footnote 1. The mere ability of a compound to act as an intermediate toward the production of other compounds does not alone constitute the sort of "property" that the cases on obviousness of chemical compounds contemplated.

- End of Case -

EXHIBIT D

FULL TEXT OF CASES (USPQ FIRST SERIES)

ACS Hospital Systems, Inc. v. Montefiore Hospital et al.

(CA FC)
221 USPQ 929
Decided Apr. 27, 1984
Nos. 83-1121 and 83-1132
U.S. Court of Appeals Federal Circuit

Headnotes**PATENTS****1. Pleading and practice in courts -- Burden of proof -- Validity (§ 53.138)****Presumption from patent grant -- In general (§ 55.1)**

Presumption of validity is never annihilated, destroyed, or even weakened, regardless of what facts are of record; rather it is clear statutory procedural device that assigns to party asserting invalidity burden of proving invalidity; burden of persuasion is, and remains always, on party asserting invalidity.

2. Construction of specification and claims -- In general (§ 22.01)**Construction of specification and claims -- By specification and drawings -- To save claim (§ 22.257)**

Claims are to be read and construed in light of specification and prosecution history of patent; further, claim should be so construed, if possible, as to sustain their validity.

3. Construction of specification and claims -- In general (§ 22.01)

Claim construction is question of law.

4. Patentability -- Anticipation -- Combining references (§ 51.205)

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Obviousness cannot be established by combining teachings of prior art to produce claimed invention, absent some teaching or suggestion supporting combination; teachings of references can be combined only if there is some suggestion or incentive to do so, under 35 USC 103.

5. Infringement -- Tests of -- Comparison with claims (§ 39.803)

Infringement is determined on basis of claims, not on basis of comparison with patentee's commercial embodiment of claimed invention.

6. Court of Appeals for the Federal Circuit -- Weight given decision reviewed

(§ 26.59)

CAFC is confined to trial court's limited findings and is forced to draw from facts found, those inferences that are necessary to support ultimate finding that patent is not infringed; in this endeavor CAFC does not itself find those facts that trial court failed to set out for it; as appellate court, CAFC lacks power to perform that exercise; where trial court fails to make findings, judgment will normally be vacated and action remanded for appropriate findings to be made; where full understanding may be had without aid of separate findings, however, narrow exception to that general rule is recognized; ultimate finding of fact in case, whether initially by trial court, or as affirmed on appeal, rests on same underpinnings, that is, necessary subsidiary facts, supported by evidence of record, that lead to ultimate finding; where district court has not misapplied controlling legal standards in its evaluation of evidence, its ultimate finding as well as subsidiary findings upon which ultimate finding necessarily depends, is subject to review on appeal under clearly erroneous standard of FedRCivP 52(a); record is examined in order to review trial court's judgment, and findings it made or necessarily had to have made to support that judgment and, thus, to conclude controversy at appellate stage without unnecessary further expenditure of judicial resources, if possible.

7. Costs -- Attorney's fees (§ 25.5)

Court of Appeals for the Federal Circuit -- Weight given decision reviewed (§ 26.59)

Prevailing accused infringer must establish that trial judge abused his discretion in regard to accused infringer's motion for attorney fees, not merely that trial judge committed clear error, in order to prevail on cross appeal on that issue.

Particular patents -- Television Switches

4,183,057, Sonnenberg, Actuating System for a Rental Television, holding of invalidity reversed; holding of noninfringement affirmed.

Case History and Disposition:

Page 929

**Appeal from District Court for the Western District of Pennsylvania,
Dumbauld, J.; 220 USPQ 731 .**

**Action by ACS Hospital Systems, Inc., against Montefiore Hospital,
and Wells National Services Corporation, for patent infringement.
From judgment for defendants, but denying attorney fees, both parties
appeal. Modified.**

Page 930

Attorneys:

Frank J. Benasutti, Philadelphia, Pa., for appellant.

**David J. Cushing, Washington, D.C. (Darryl Mexic, Washington,
D.C., on the brief) for appellees.**

Judge:

Before Miller and Smith, Circuit Judges, and Re, Judge. *

Opinion Text**Opinion By:**

Smith, Circuit Judge.

In this patent case, ACS Hospital Systems, Inc. (ACS), appeals from a judgment of the U.S. District Court for the Western District of Pennsylvania holding U.S. patent No. 4,183,057, issued to Sonnenberg (the Sonnenberg patent), invalid as obvious under 35 U.S.C. §103 (1976) and not infringed. Montefiore Hospital and Wells National Service Corp. (Wells) cross-appeal from the district court's denial of their motion for attorney fees. The judgment is reversed with respect to invalidity and affirmed with respect to noninfringement. With respect to Wells' cross-appeal from the denial of attorney fees, the judgment is affirmed.

Background

ACS's Sonnenberg patent claims a rental television system comprising a key operated actuating switch, an override switch, and a signal light to indicate that the override switch has been actuated. When the key switch is in the "on" position, the television operates normally. For rental use, the key switch is placed in the "off" position by a key operator.

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In order to rent the television, the viewer depresses the override switch which enables the television to operate normally without the necessity of turning on the key operated switch. When the override switch has been activated the indicator signal is illuminated, signaling that the television has been rented. Claim 1 is representative:

A television system constructed for rental use, the television system comprising: actuating means including a key operated switch switchable between an off position for preventing normal operation of the television and an on position for enabling the television to be operated;

override switching means capable of being switched from a normal position to an actuated position for overriding said key operated switch when in its off position and enabling the television to be operated; and said override switching means when switched in to [sic] its actuated position remains in said position until said key operated switch is switched into its on position; and

indicating means for providing an indicating signal when said override switching means has been switched into its actuated position.

Validity

The trial court held the claims of the Sonnenberg patent invalid under section 103. While the trial court's opinion deals predominantly with infringement, the court purported to apply the standards articulated in *Graham v. John Deere Co.*¹ in determining the issue of validity. In concluding that the Sonnenberg patent is invalid under section 103, the district court relied on override switches generally and ACS's 'COMPU-TEL' fully automated television rental system as prior art.

The court below stated that "the overriding of switches by providing an alternative path for current to actuate an appliance is a commonly practiced technique well known in the art prior to Sonnenberg's patent." It held that his claim 1 is therefore invalid as obvious. The trial judge adopted Wells' expert's description of ACS's COMPU-TEL system and held the Sonnenberg patent invalid as an attempt by ACS to "monopolize all systems of enabling a hospital patient to view television * * * without the aid of an attendant." (Emphasis in original.) He commented that "[t]he statutory presumption [of validity] of 35 U.S.C. 282 is entirely annihilated by the indisputable facts in the record."

Presumption of Validity

[1] As an initial matter, we hold that the trial court's treatment of the presumption of validity is incorrect as a matter of law. The presumption is *never* annihilated, destroyed, or even weakened, regardless of what facts are of record.² Rather, it is a clear statutory procedural device which assigns to the party

Page 931

asserting invalidity the burden of proving invalidity.³

A patent shall be presumed valid. * * * The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.⁴

The burden of persuasion is, and remains always, on the party asserting invalidity.⁵ In the present case this error is not harmless. The district court's holding of invalidity has been shown, on the entire record, to have been reached on the basis of *both* clearly

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erroneous findings of fact and misapplication of the law.⁶

Section 103

This court has in recent months issued a number of opinions addressing the analysis of obviousness under section 10⁷ and those opinions provide a comprehensive guide to analysis. We hold that the trial court's analysis of obviousness is inadequate under Graham⁸ to sustain a holding of invalidity under section 103. However, the trial court's opinion contains sufficient findings of fact, supported in the record, to enable us to review the conclusion below that the Sonnenberg patent is invalid.

Scope and Content of the Prior Art .

In determining the scope and content of the prior art, the trial court found that override switches generally were well known in the art. It also found that ACS's COMPU-TEL system was within the prior art under section 102(g). The district court did not in its opinion rely on any other prior art reference in determining whether the claimed invention would have been obvious under section 103.

Five U.S. patents⁹ are cited in the Sonnenberg patent as prior art. Further, the parties refer to the "Western New York Hospital" rental television system as prior art. While the trial judge made no mention in his opinion of these additional references, on the basis of the record before us, they each constitute prior art relative to the Sonnenberg patent. We hold that the trial court's limited assessment of the prior art was clearly erroneous in that the court below failed to find that these additional references are within the scope and content of the prior art. These errors, however, have not been shown to have influenced the trial court's judgment in this case and, accordingly, we consider them harmless.

Differences .

With respect to the differences between the claimed subject matter and the prior art, the district court gave claim 1 of the Sonnenberg patent an extremely broad construction. It adopted the opinion of Wells' expert that the COMPU-TEL system contains every feature of claim 1. Hence, the court below found no significant differences between the claimed subject matter and the prior art. We hold that finding to be clearly erroneous. In addition, that finding reflects an erroneous construction of the claims.

The trial court in its discussion of obviousness, rather than ascertaining the differences between the claimed subject matter and the prior part, focused on the differences between

Page 932

the Wells and the ACS systems. In so doing, it adopted Wells' expert's explanation of the differences between claim 1 and the Wells system -- differences relating to literal infringement, not validity. We conclude that the trial court erred in adopting Wells' expert's interpretation of claim 1.

Differences between the prior art and the claimed invention are apparent from the record. First, while override switches are used in a wide variety of applications, the examples of override switches cited by the district court are not relevant to the claimed subject matter as a whole -- television rental systems. The district court made no attempt in its opinion to identify the differences between the override switching examples that it cited and the claimed subject matter.

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Second, the record discloses that COMPU-TEL is a fully automated television rental system whereas the claimed invention involves human monitoring and control. While COMPU-TEL and the claimed invention both exhibit certain switching elements, the functions of the switching elements in the two systems are different. The fully automated operation of the COMPU-TEL system does not involve overriding a locked key switch. The patient switch in the COMPU-TEL system functions to actuate the television as well as to initiate billing. The override switching means claimed in the Sonnenberg patent, on the other hand, functions to provide an alternative current path to the locked key switch and to actuate the indicator light.

Third, the prior art of record that the court did not discuss also differs significantly from the claimed subject matter. The five patent references cited in the Sonnenberg patent involve a variety of lock, metering, and control systems. None of them, however, employs an override switching mechanism to overcome a key operated actuating switch. The Western New York Hospital system involves a three position key switch. Yet, that system differs from the claimed subject matter in that it too does not employ override switching means.

Hence, we hold the trial court's assessment, that there are no differences between the claimed subject matter and the prior art, was clearly erroneous.

Level of Ordinary Skill and Secondary Considerations .

Additionally, the court below made no express finding with respect to the level of ordinary skill in the art. The trial court's analysis, however, clearly indicates that the level of skill was considered to be quite low. We interpret the court's findings as fixing the level of ordinary skill in the art as that of a layman. That finding has not been shown to be clearly erroneous. The court made no findings with respect to secondary considerations.

Claim Construction .

As noted above, the trial court's opinion reflects an extremely broad construction of the claims. Contrary to the district court's construction of the claims, the Sonnenberg patent does not claim " *all* systems of enabling a hospital patient to view television normally under his own power without the aid of an attendant." (Emphasis in original.) The court ignored express claim limitations governing the function of the switching means.

[2][3] Claims are to be read and construed in light of the specification and the prosecution history of the patent.¹⁰ Further, claims should be so construed, if possible, as to sustain their validity.¹¹ Applying these principles, the claims of the Sonnenberg patent should be given a far more limited construction than that given by the district court in holding the claims invalid. The claims are limited to a system in which override switching means function to override a key switch when in its "off" position, enabling the television to operate normally. The Sonnenberg patent does not claim " *all* " hospital rental systems capable of operation without an attendant. Claim construction is a question of law.¹² We hold that the trial court's construction of the claims is incorrect as a matter of law.

Obviousness .

Turning now to the determination of obviousness under section 103, we conclude that

none of the references, either alone or in combination, would have disclosed or suggest

Page 933

ed to one of ordinary skill in the art the use of override switching means in a television rental system. The trial court's heavy reliance on the widespread use of override switches appears to be no more than hindsight reconstruction of the claimed invention. The court below identified no source, other than the Sonnenberg patent itself, for the suggestion to use override switching means in a television rental system.

[4] Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination.¹³ Under section 103, teachings of references can be combined *only* if there is some suggestion or incentive to do so.¹⁴ The prior art of record fails to provide any such suggestion or incentive. Accordingly, we hold that the court below erred as a matter of law in concluding that the claimed invention would have been obvious to one of ordinary skill in the art under section 103.

Infringement

The trial court found that the Wells system does not infringe the claimed invention, either literally or under the doctrine of equivalents. Once again adopting the testimony of Wells' expert, the court below found that "the Wells system does not contain the element of overriding a locked switch." The district court also found differences between the ACS system and the Wells device with respect to the mechanism and circuitry of the actuating switch as well as with respect to the indicator light.

[5] These latter findings, however, will not support a finding of no infringement. The claims of the Sonnenberg patent are not limited to a specific switching mechanism or to specific indicator light circuitry. The district court appears to have compared the Wells system with ACS's commercial product, rather than with the claims of the Sonnenberg patent. Infringement is determined on the basis of the claims, not on the basis of a comparison with the patentee's commercial embodiment of the claimed invention.

[6] The district court's failure to supply more comprehensive findings of fact compounds the difficulty of appellate review, particularly in view of the complexity of the technical subject matter of this appeal. Findings of fact are to be construed liberally in support of a judgment. Confined to the trial court's limited findings, we are forced to draw from the facts found those inferences that are necessary to support the ultimate finding that the Sonnenberg patent is not infringed by Wells.¹⁵

In this endeavor we are not ourselves finding those facts which the trial court failed to set out for us. As an appellate court, we lack the power to perform that exercise. Where the trial court fails to make findings, the judgment will normally be vacated and the action remanded for appropriate findings to be made.¹⁶ Where a full understanding may be had without the aid of separate findings, however, we recognize a narrow exception to that general rule.¹⁷

The ultimate finding of fact in a case, whether initially by the trial court, or as affirmed on appeal, rests on the same underpinnings, i.e., the necessary subsidiary facts, supported by evidence of record, that lead to that ultimate finding. Where the district court has not misapplied the controlling legal standards in its evaluation of the evidence,

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its ultimate finding as well as the subsidiary findings upon which the ultimate finding necessarily depends, is subject to review on appeal under the clearly erroneous standard of Fed.R.Civ.P. 52(a).¹⁸ We examine the record in order to review the trial court's judgment, and the findings it made or necessarily had to have made to support that judgment and, thus, to conclude the controversy at this stage without unnecessary further expenditure of judicial resources, if possible.

The Sonnenberg Claims .

The Sonnenberg patent claims a rental television system having key operated actua

Page 934

ting means capable of being overridden by an override switching means. An indicating means signals that the override switching means has been actuated. Once overridden, the switches and the indicator light remain in their overridden positions until the key operated switch is switched on, resetting the override switching and indicating means.

The Accused Infringing Device .

The Wells device also contains each of the three physical elements of claims 1 of the Sonnenberg patent: (1) a key operated actuating switch; (2) a remote control actuating switch; and (3) an indicator light. The district court, however, found that the Wells device does not contain the claimed limitation of overriding a locked switch -- a difference in function.

The Wells device is a modified version of a standard hospital/hotel/motel television receiver. The keylock in the Wells system actuates 5 switches: S1XA; S1XB; S1B; S1C; and S1D [Fig. 1].

Tabular, graphic, or textual material set at this point is not available. Please consult hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323.

In the Wells device, the jumper wires, provided by the manufacturer on switches S1B and S1C, are not removed. [Fig. 2.]

Tabular, graphic, or textual material set at this point is not available. Please consult hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323.

Switches S1B and S1C are shorted out by those jumper wires, rendering those switches electrically inoperable.

Additionally, switch S1D [Fig. 1] is "replaced" by relay RL-2 [Fig. 3] of the Wells remote control circuit.

Tabular, graphic, or textual material set at this point is not available. Please consult hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323.

Relay RL-2 is connected in parallel with switch S1D and one of the leads to switch S1D is cut between switch S1D and the connection of the lead to relay RL-2 [Fig. 3]. Thus, the circuit through switch S1D is broken, rendering that switch electrically inoperable.

Unlike switch S1D which it replaces, relay RL-2 is not controlled by the key switch. Rather, switch S1 [Fig. 3], located on the remote control unit, operates relay RL-2 in the Wells device. When S1 is not depressed, relay RL-2 remains normally closed. When

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switch S1 is depressed, the coil in relay RL-2 is energized causing relay RL-2 to open. Similarly, switch S1D, which relay RL-2 replaces, was normally closed when the television was not rented and was opened by turning the key switch to rent the television.

Switches S1B, S1C, and S1D, therefore, are disabled in the Wells device. The key switch operates only two switches -- S1XA and S1XB [Fig. 1] -- which control the delivery of power to the television receiver. When these switches are closed [positions 2

Page 935

and 3] [Table 1], power is delivered to the tuner; when these switches are open [position 1] [Table 1], the circuit is broken and no power reaches the tuner.

Tabular, graphic, or textual material set at this point is not available. Please consult hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323.

As manufactured, when the key switch of a standard receiver is in position 2 [Table 1], switch S1D is open and the television operates normally. Position 2 functions as an "on" setting in the standard receiver. In the Wells device, however, switch S1D [Table 1] has been disconnected and it has been replaced by relay RL-2. Relay RL-2 cannot be opened by manipulation of the key switch, as was switch S1D. Thus, the receiver cannot be actuated merely by turning the key switch to position 2 in the Wells device.¹⁹ Switch S1 opens relay RL-2. The Wells receiver can be made fully operable only by depressing switch S1 [Fig. 3] while master on-off switches S1XA and S1XB are closed -- position 2 or 3 [Table 1].

When the key switch is in position 1, power is interrupted and depressing actuating switch S1 will not actuate the receiver. The Wells key switch performs the same function in position 2 as in position 3. In both of these positions, while power is supplied to the tuner, the actuating switch S1 must be depressed in order to actuate the television. Thus, switch S1 does not override the key switch of the Wells device.²⁰ Switch S1 and the key switch are electrically independent in the Wells device [Fig. 4].

Tabular, graphic, or textual material set at this point is not available. Please consult hard copy or call BNA PLUS at 1-800-452-7773 or 202-452-4323.

In summary, the Wells device exhibits three modes of operation: (1) off -- locked out (switches S1XA and S1XB open); (2) rentable -- key position 2 or 3 and S1 not actuated (switches S1XA and S1XB closed and switch S1 open); and (3) rented -- key position 2 or 3 and S1 actuated (switches S1XA and S1XB closed and switch S1 closed). Normal operation of the Wells device can be achieved *only* by depressing S1 *while* the power is switched on (key switch position 2 or 3). The invention claimed in the Sonnenberg patent, on the other hand, also exhibits three modes of operation: (1) "off" -- rentable (override switch not actuated); (2) "On" -- rented (override switch actuated); and (3) "on" -- key operation (key switch turned on and override switch not actuated).

On the basis of our examination of the record we infer that the district court neces

Page 936

sarily found the following relative to the Wells device: (1) switches S1B, S1C, and S1D
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are disabled; (2) the key switch controls only switches S1XA and S1XB -- the master on-off switch; and (3) the receiver can be actuated only by depressing S1 while the key switch is in either position 2 or 3 (so that switches S1XA and S1XB are closed).

Literal Infringement

These implied findings lead inexorably to the district court's express finding that the Wells device lacks the claimed limitation of overriding a locked key switch. Further, these findings indicate that the Wells device does not exhibit the claimed "on" key switch position.

Both the "on" and "off" positions recited in claim 1 correspond to the "on" positions [positions 2 and 3] of the key switch in the Wells device. The Wells device cannot be operated normally through the key switch alone, as is required by claim 1. Rather, switch S1 must be depressed in conjunction with power being supplied to the receiver through the key switch. Hence, on the basis of the record before us, we conclude that the district court's finding, that Wells does not literally infringe the claims of the Sonnenberg patent, is not clearly erroneous.

Doctrine of Equivalents

While the district court purported to apply the standard articulated in *Graver Tank & Manufacturing Co. v. Linde Air Products Co.*,²¹ it entered no findings on the issue of equivalence: whether the Wells device performs substantially the same function as the claimed invention in substantially the same way to obtain substantially the same result.²² Yet, the court clearly implied that Wells does not infringe the Sonnenberg patent under the doctrine of equivalents and entered judgment to that effect.

We infer that the district court necessarily found that the Wells device, lacking the claimed function of overriding a locked key switch, does not function in substantially the same way as the claimed invention. That inference is supported by the record.

Accordingly, we conclude that the district court's finding, that the Wells device does not infringe the Sonnenberg patent under the doctrine of equivalents, is not clearly erroneous.

Hence, we affirm in part the judgment of the district court insofar as it relates to the finding that the Wells device does not infringe the claims of the Sonnenberg patent, either literally or under the doctrine of equivalents.

Attorney Fees

[7] The trial judge found that this is not an exceptional case and denied Wells' request for attorney fees. In order to prevail on its cross-appeal, Wells must establish that the trial judge abused his discretion in this regard and not merely, as Wells' attorneys contend, that the trial judge committed clear error. Wells has not demonstrated the requisite abuse of discretion, although it attempts to do so by demonstrating alleged fraudulent conduct by ACS before the Patent and Trademark Office. Fraud has not been shown. Nor have other facts been established that would demonstrate that the trial judge abused his discretion in finding that this case is not exceptional. Thus, we affirm the district court's denial of Wells' motion for attorney fees.

Conclusion

In summary, we hold that the district court committed both clear errors of fact and errors of law with respect to its resolution of the validity issue. The district court's conclusion that the Sonnenberg patent is invalid under section 103 is incorrect as a matter

of law. We conclude that the trial court's finding, that Wells does not infringe the claims of the Sonnenberg patent, either literally or under the doctrine of equivalents, is not clearly erroneous. Additionally, we hold that the trial judge did not abuse his discretion in denying Wells' motion for attorney fees.

Affirmed-in-part. reversed-in-part.

Footnotes

Footnote 1. *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966).

Footnote 2. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1534, 218 USPQ 871, 875-76 (Fed.Cir. 1983).

Footnote 3. *Id.*

Footnote 4. 35 U.S.C. §282 (1976).

Footnote 5. *Stevenson v. U.S. Int'l Trade Comm'n*, 612 F.2d 546, 551, 204 USPQ 276, 281 (CCPA 1979); *Solder Removal Co. v. U.S. Int'l Trade Comm'n*, 582 F.2d 628, 632-33, 199 USPQ 129, 132-33 (CCPA 1978). See also *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed.Cir. 1983); *Medtronic, Inc. v. Cardiac Pacemakers, Inc.*, 721 F.2d 1563, 220 USPQ 97 (Fed.Cir.1983); *Stratoflex*, 713 F.2d at 1534, 218 USPQ at 875-76; *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 773-74, 218 USPQ 781, 790 (Fed. Cir. 1983).

Footnote 6. Cf. *Medtronic*, 721 F.2d at 1566, 220 USPQ at 99 (errors in decisional approach considered harmless).

Footnote 7. *In re Sernaker*, 702 F.2d 989, 217 USPQ 1 (Fed. Cir. 1983); *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 217 USPQ 193 (Fed. Cir. 1983); *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 217 USPQ 1281 (Fed.Cir. 1983); *Chore-Time Equip., Inc. v. Cumberland Corp.*, 713 F.2d 774, 218 USPQ 673 (Fed. Cir. 1983); *Carl Schenck, A.G. v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed.Cir. 1983); *Environmental Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 218 USPQ 865 (Fed.Cir. 1983); *Stratoflex*, 713 F.2d 1530, 218 USPQ 871 .

Footnote 8. *Graham*, 383 U.S. at 17-18, 148 USPQ at 467, provides, in pertinent part:

"* * * [Section] 103 * * * lends itself to several basic factual inquiries. Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. * * *"

Footnote 9. *Norris*, U.S. patent No. 2,856,474; *Townsend*, U.S. patent No. 3,188,384; *Sargent*, U.S. patent No. 3,335,421; *Daniel*, U.S. patent No. 3,631,444; and *Kosco*, U.S. patent No. 3,886,302.

Footnote 10. *Fromson v. Advance Offset Plate, Inc.*, 720 F.2d 1565, 1570-71, 219 USPQ 1137, 1140-41 (Fed.Cir. 1983); *Autogiro Co. v. United States*, 384 F.2d 391, 397-99, 155 USPQ 697, 702-04 (Ct. Cl. 1967).

Footnote 11. Carman Indus., Inc. v. Wahl, 724 F.2d 932, 937 n.5, 220 USPQ 481, 485 n.5 (Fed. Cir. 1983); Klein v. Russell, 86 U.S. 433, 466 (1874); Turrill v. Michigan S. & N.I.R.R., 68 U.S. 491, 510 (1864).

Footnote 12. Autogiro, 384 F.2d at 397-99, 155 USPQ at 702-04; LaSalle v. Carlton's Laydown Serv., Inc., 680 F.2d 432, 216 USPQ 276 (5th Cir. 1982); Studiengesellschaft Kohle mbH v. Eastman Kodak Co., 616 F.2d 1315, 206 USPQ 577 (5th Cir.), cert. denied, 449 U.S. 1014, 208 USPQ 88 (1980).

Footnote 13. Orthopedic Equip. Co., 702 F.2d at 1012, 217 USPQ at 199; cf. In re Samour, 571 F.2d 559, 563, 197 USPQ 1, 4 (CCPA 1978) (noting the rule in the §103 context and declining to extend that rule to §102(b) rejections); Corometrics Medical Sys., Inc. v. Berkeley Bio-Engineering, Inc., 193 USPQ 467, 475 (N.D. Cal. 1977).

Footnote 14. In re Rinehart, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); In re Regel, 526 F.2d 1399, 188 USPQ 136 (CCPA 1975); In re Avery, 518 F.2d 1228, 186 USPQ 161 (CCPA 1975); In re Imperato, 486 F.2d 585, 179 USPQ 730 (CCPA 1973); In re Andre, 341 F.2d 304, 144 USPQ 497 (CCPA 1965).

Footnote 15. 5A J. MOORE, J. LUCAS, MOORE'S FEDERAL PRACTICE ¶52.06[1] (2d ed. 1984).

Footnote 16. Pullman-Standard v. Swint, 456 U.S. 273, 292 n.22 (1982); 5A MOORE'S FEDERAL PRACTICE ¶52.06[2].

Footnote 17. See 5A MOORE'S FEDERAL PRACTICE ¶52.06[2] n.4 and cases cited therein.

Footnote 18. Cf. Pullman-Standard, 456 U.S. 273.

Footnote 19. It appears that had RL-2 and S1D been wired in series, instead of in parallel with S1D disabled, the Wells device would exhibit the claimed "on" function.

Footnote 20. Our assessment of the operation of the Wells device is based on the trial court's findings and on the documentary and testimonial evidence of record. It appears that only switches S1XA and S1XB are controlled by the key switch. Thus, our analysis supports the trial judge's implication that there is no functional difference between positions 2 and 3 of the key switch. The above analysis assumes that the key switch does not operate some third circuit that is actuated in either position 2 or position 3, but not both. We are aware of no evidence that such a third circuit fulfills the role of the key switch and is in turn overridden by switch S1.

Footnote 21. Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 607-09, 85 USPQ 328, 330-331 (1950).

Footnote 22. Id. at 608, 85 USPQ at 330; Sanitary Refrigerator Co. v. Winters, 280 U.S. 30, 42, 3 USPQ 40, 44 (1929).

Footnote * The Honorable Edward D. Re, Chief Judge, United States Court of International Trade, sitting by designation.

- End of Case -

EXHIBIT E

FULL TEXT OF CASES (USPQ2D)

All Other Cases

**Custom Accessories Inc. v. Jeffrey-Allan Industries Inc.
(CA FC) 1 USPQ2d 1196 Custom Accessories Inc. v.
Jeffrey-Allan Industries Inc.**

**U.S. Court of Appeals Federal Circuit
1 USPQ2d 1196**

**Decided December 12, 1986
No. 85-2728**

Headnotes

PATENTS

1. Patentability/Validity -- Obviousness -- Evidence of (§ 115.0903)

Federal district court erred by holding claimed mud flap or splash guard assembly invalid for obviousness, since court improperly focused on patent as "combination of old elements," ignored objective evidence of nonobviousness, paid lip service to presumption of validity, and failed to make sufficient findings of fact as to scope and content of prior art, differences between prior art and claims at issue, level of ordinary skill in art, and objective evidence of nonobviousness such as whether there was "nexus" between commercial success and claimed invention.

Particular patents -- Mud Flaps

4,264,083, Matthew, et al. Splash Guard or Mud Flap Assembly, holding of invalidity reversed.

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Case History and Disposition:

Page 1196

**Appeal from District Court for the Northern District of Illinois,
Moran, J.**

Action by Custom Accessories Inc., against Jeffrey-Allan Industries Inc., for patent infringement, in which defendant counterclaimed for declaration of invalidity. From judgment for defendant, plaintiff appeals. Reversed and remanded.

Attorneys:

Richard D. Harris, and Dick & Harris, both of Chicago, Ill. (Richard Eugene Dick, Max Shaftal, and Dick & Harris, all of Chicago, Ill., on the brief) for appellant.

John C. Brezina, and Brezina & Buckingham P.C., both of Chicago, Ill. (David C. Brezina, and Brezina & Buckingham P.C., both of Chicago, Ill., on the brief) for appellee.

Judge:

Before Davis and Smith, Circuit Judges, and Re, Chief Judge (of the U.S. Court of International Trade, sitting by designation).

Opinion Text**Opinion By:**

Smith, Circuit Judge.

This is an appeal by Custom Accessories, Inc. (Custom), from a judgment of the United States District Court for the Northern District of Illinois, Eastern Division, holding invalid under 35 U.S.C. §103 claims 1 and 6 of United States Patent No. 4,264,083 (the '083 patent). We vacate and remand.

Background

The facts recited in this opinion, unless otherwise indicated, are either uncontested by the parties or are findings of the district court not shown to have been clearly erroneous. FED. R. CIV. P. 52(a).

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1. The Technology

Mud flap or splash guard assemblies are commonly used on motor vehicles to prevent damage to the frame due to pebbles, salt, mud, and other debris thrown from the vehicle path by rotating wheels. They are placed in close proximity to a wheel and occupy a rearward position relative to the primary direction of travel of the motor vehicle. The assembly usually includes a splash intercepting body portion, such as a flat resilient flap or a rigid metallic plate of light construction, anchored by a fastener to a fender area of the vehicle.

2. The Patent

The '083 patent was issued on April 28, 1981, to Matthew, *et al.*, and was assigned to Custom. A reissue patent application was filed on June 23, 1981, in the name of the original inventors. On February 19, 1982, Pretty Products, Inc., filed a request for reexamination in light of nine references not considered during prosecution. On June 3, 1982, the United States Patent and Trademark Office (PTO) merged the reissue application with the reexamination proceeding. Custom then expressly abandoned the reissue application on June 17, 1982. Original claims 1 and 6 were amended during, and ultimately survived, reexamination. A reexamination certificate including those claims was issued on March 22, 1983.

Claim 1 reads as follows:

1. A splash guard or mud flap assembly for attachment to the fender of a motor vehicle, comprising: a flexible, splash-intercepting body portion; resilient, self-sustaining anchoring means for supporting the body portion and being adapted to be snugly engaged along the fender of a motor vehicle for securing the body portion in a splash-intercepting position thereon, said anchoring means including a front wall and a back wall resiliently integrally joined along one side in substantial overlying relation to one another and converging in the direction of the free ends thereof,

Page 1197

the free ends of said walls being resiliently separable a distance to enable the anchoring means to be snugly frictionally engaged on a motor vehicle fender, the resiliency of the anchoring means being such that the front wall and the back wall thereof provide substantially the total gripping force for maintaining the anchoring means on a motor vehicle fender while providing a rigid support base for the splash-intercepting body portion of the splash guard, and an outwardly extending pin-like member carried on the front wall of the resilient anchoring means in spaced, inward relation to the free ends of said walls of the anchoring means for engaging and retaining said body portion on the anchoring means, said pin-like member being provided with locking means for securing and maintaining the splash-intercepting body portion on the anchoring means, said locking means being characterized in that it overlies and is in contact with a sufficient area of the splash-intercepting body portion to resist any forces tending to dislodge said body portion from the pin-like member.

Claim 6 recites:

A splash guard or mud flap assembly as claimed in claim 1 wherein the pin-like member

of the anchoring means is provided with external threads for receiving a nut-like retaining member for securing and maintaining the splash-intercepting body portion on the anchoring means, said nut-like retaining member being characterized in that the base of the nut-like retaining member overlies and is in contact with a sufficient area of said body portion to resist any forces tending to dislodge the body from the pin-like member.

3. District Court Proceeding

Custom filed suit in the district court alleging infringement by appellee Jeffrey-Allan Industries, Inc. (Jeffrey-Allan). Jeffrey-Allan denied infringement. It also raised as affirmative defenses and counterclaimed that claims 1 and 6 were invalid on the grounds of obviousness under 35 U.S.C. §103, improper inventorship under 35 U.S.C. §102(f), and overclaiming under 35 U.S.C. §112.

The district court judge entered judgment for Jeffrey-Allan for the reasons contained in a July 26, 1985, "Memorandum and Order" that constituted the court's findings of fact and conclusions of law. The district court found claims 1 and 6 of the '083 patent invalid under 35 U.S.C. §103, 1 but did not adjudicate any other issue. The Memorandum and Order does state, however, that "[d]efendant does not seriously contend that its splash guard assembly does not infringe."

Issue

Whether the district court erred in holding that claims 1 and 6 of the '083 patent are invalid under 35 U.S.C. §103.

Opinion

Section 103 of 35 U.S.C. precludes a patent grant if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. * * *

Though the ultimate question is one of law, a determination of obviousness under section 103 is based on these factual inquiries set forth in *Graham v. John Deere Co.* : 2 (a) the scope and content of the prior art; (b) the differences between the prior art and the claims at issue; (c) the level of ordinary skill in the art; and (d) objective evidence of nonobviousness. 3

Under *Graham*, a district court makes proper fact findings on those four inquiries and then assesses the ultimate legal question of nonobviousness. Thus, given the scope and content of the prior art, the differences between the claimed invention and the prior art, the level of ordinary skill in the art, and the existence of commercial success and any other objective considerations of nonobviousness, the district court determines whether the claimed invention would have been obvious to one of ordinary skill in the appropriate art at the time the invention was made.

[1] At the conclusion of its 7-1/2 page Memorandum and Order, the district court for the first time cites *Graham*, stating:

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This court concludes, in accordance with the teachings of *Graham v. John Deere Co.*., 383 U.S. 1 [148 USPQ 459 (1966); *Dual Mfg. & Engineering, Inc. v. Burris Industries, Inc.*, 619 F.2d 660 [205 USPQ 1157] (7th Cir.) (*en banc*), cert. denied , 449 U.S. 870 [207 USPQ 1064] (1980) and *Republic Industries, Inc. v. Schlage Lock Co.*., 592 F.2d 963 [200 USPQ 769] (7th Cir. 1979), that the use of that anchoring means rather than another in an old combination was, in the circumstances of this case, obvious within the meaning of section 103.

That fleeting reference to *Graham* does not convince us that the district court in fact properly analyzed obviousness using the *Graham* analysis. Indeed, Custom has persuaded us to the contrary. That *Graham* was not properly applied is evidenced by the district court: (1) improperly focusing on "a combination of old elements"; (2) ignoring objective evidence of nonobviousness; (3) paying lip service to the presumption of validity; and (4) failing to make sufficient *Graham* findings.

A. Improperly Focusing on a Combination of Old Elements .

In assessing the patentability of Custom's device, the district court's Memorandum and Order refers to "a combination of old elements," which "is not necessarily an invention" but is entitled to patent protection if the combination "causes a new and useful result." Though it perceives one of the elements (the protruding pin in the anchoring means) as possibly novel, it states:

A U-clip with a locked pin surely was not itself patentable as an independent invention. Indeed, the plaintiff cancelled claims limited to the anchoring means during reexamination, when they were rejected as obvious. * * *

Such an approach is improper.

The dispositive question is not whether the claimed device is an "invention"; rather, it is whether the invention satisfies the standards of patentability. 35 U.S.C. §§100-103. To suggest that Custom's new combination "is not necessarily an invention" or otherwise to require some concept of "inventiveness" or "flash of genius" for patentability would improperly misplace the focus of 35 U.S.C. §103. 4

That each element in a claimed invention is old or unpatentable does not determine the nonobviousness of the claimed invention as a whole. "There is no basis in the law * * * for treating combinations of old elements differently in determining patentability." 5 As stated in *Stratoflex* : 6

The reference to a "combination patent" is equally without support in the statute. There is no warrant for judicial classification of patents, whether into "combination" patents and some other unnamed and undefined class or otherwise. Nor is there warrant for differing treatment or consideration of patents based on a judicially devised label. Reference to "combination" patents is, moreover, meaningless. Virtually *all* patents are "combination patents," if by that label one intends to describe patents having claims to inventions formed of a combination of elements. It is difficult to visualize, at least in the mechanical-structural arts, a "non-combination" invention, i.e., an invention consisting of a *single* element. * * * [Emphasis in original.]

Casting an invention as "a combination of old elements" leads improperly to an analysis of the claimed invention by the parts, not by the whole. That is what seems to have happened here. The critical inquiry is whether "there is something in the prior art as a whole *to suggest* the desirability, and thus the obviousness, of making the combination."

" 7

A traditional problem with focusing on a patent as a "combination of old elements" is the attendant notion that patentability is undeserving without some "synergistic" or "different" effect. Here, the district court spoke of the need for "a new and useful result." Such tests for patentability have

Page 1199

been soundly rejected by this court.⁸ Though synergism is relevant when present, its "absence has no place in evaluating the evidence on obviousness."⁹ The district court's citation to *Dual Manufacturing*¹⁰ together with *Graham v. John Deere*, supports our conclusion that the district court was misled by improper "combination" notions. *Dual Manufacturing* expressly adopts the type of rationale regarding "combination patents" and synergism that this court has expressly rejected and only serves to confuse the real test of obviousness prescribed by the 1952 Patent Act. Though *Republic Industries, Inc. v. Schlage Lock Co.*,¹¹ also cited by the district court, is more in tune with Federal Circuit precedent on combination patents and synergism, the possibility exists that the district court gave more credence to *Dual Manufacturing* because it was decided in banc and subsequent to *Republic Industries*.

B. Ignoring Objective Evidence of Nonobviousness .

The district court found that Custom's "assembly was an improvement, as persuasively evidenced by its adoption by competitors."¹² Though "not a major breakthrough," stated the court, "it was a better mousetrap than those on the market," and "[o]thers have adopted that design, so that it has become a commonly sold configuration, thus providing support for a contention of commercial success, although plaintiff has had virtually no success in persuading its competition to take licenses." After saying that, however, the district court seemed to ignore the concrete evidence of copying and commercial success. Failure to consider such evidence is clearly error.

Under *Graham*, objective evidence of nonobviousness includes commercial success, longfelt but unresolved need, failure of others, and copying.¹³ When present, such objective evidence must be considered.¹⁴ It can be the most probative evidence of nonobviousness in the record, and enables the district court to avert the trap of hindsight.¹⁵ On the other hand, the absence of objective evidence does not preclude a holding of nonobviousness because such evidence is not a requirement for patentability.¹⁶ As stated in *Medtronic, Inc. v. Intermedics, Inc.*,¹⁷ the absence of objective evidence "is a neutral factor."

The district court's failure to consider objective evidence was probably fueled by the two cases it cited together with *Graham*. Both *Dual Manufacturing* and *Republic Industries* mistreat the importance of objective evidence, such as commercial success. They incorrectly state that such objective criteria "without invention will not make patentability."¹⁸

C. Paying Lip Service to the Presumption of Validity

A patent is presumed valid.^{35 U.S.C. §282} Indeed, each claim of a patent is presumed valid independently of the validity of other claims. *Id.* The burden is on the party

asserting invalidity to prove the invalidity of each claim (here, claims 1 and 6) with facts supported by clear and convincing evidence. 19

Page 1200

Though the district court stated that the presumption operates to "shift the burden of proof," the Memorandum and Order does not indicate a recognition by the district court that the burden is by clear and convincing evidence. Moreover, the Memorandum and Order occasionally suggests that the district court may have incorrectly placed the burden on the patentee to establish validity. For example, it states: "This court finds unpersuasive plaintiff's contention that Bedford does not anticipate * * *." 20 Nor did the district court give any credence to the PTO reexamination proceeding, which upheld the validity of claims 1 and 6 despite the presence of much the same art as was presented before the district court. In *Interconnect Planning Corp. v. Feil*, 21 this court stated that an examiner's decision on an original or reissue application is "evidence the court must consider in determining whether the party asserting invalidity has met its statutory burden by clear and convincing evidence," and that, upon reissue, the burden of proving invalidity was "made heavier." 22

D. Failing To Make Sufficient Graham Findings .

The amount and specificity of findings needed are determinations to be made on a case-by-case basis. 23 "[W]e must be convinced from the opinion that the district court actually applied *Graham* and must be presented with enough express and necessarily implied findings to know the basis of the trial court's opinion." 24 Certainly, when significant legal errors are reflected in the opinion, as here, which themselves shed doubt on the district court's use of *Graham*, the need for findings becomes greater and their absence rises to the level of error. 25

In this case, the failure of the district court to make sufficient *Graham* findings was not in fact properly applied. The findings were insufficient in at least three regards:

(1) Scope and Content of Prior Art/Differences Between Prior Art and Claimed Invention

The Memorandum and Order briefly discusses as prior art United States patents to Bedford, Jr., and to Wootton, a line of "Au-ve-co" devices, a Tinnerman parts catalogue, and a Rubber Queen assembly. However, the Memorandum and Order does not make clear which reference/devices (references) or combination of references provides the basis for determining obviousness. It is also not clear what teachings are relied on from each reference, and how each reference differs from the claimed invention.

Some differences were found, but improperly considered by the district court. For one, the district court did not find a teaching in any reference of a pin protruding or extending from a clip, but dismissed that difference by stating:

That the Au-ve-co unit and the Wootton patent disclosed an anchoring means in which a bolt threaded into the clip rather than a pin projecting from the clip does not dilute the force of the disclosure. Indeed, the idea taken to DeChant could have ended up in commercial production in that form. * * *

It is unclear what is meant by "does not dilute the force of the disclosure." Clearly, the district court identified a difference between the claimed invention and the prior art -- the protruding pin. Before deeming the claimed invention obvious, the district court would have to find some suggestion in the references for using an "outwardly extending pin-like member," as required by the claims.

The district court also stated:

What was brought to him [DeChant, who designed the fastener] was the idea, reduced to practice in a primitive form, of an anchoring means in a splash guard assembly which used a pin attached as part of a clip and projecting through the splash guard. There was no reason, in light of the conception, that the attachment to the clip could not have been by screwing a bolt into threads [like in the prior art] * * *

That approach appears inappropriately to perceive an element of the claimed invention

Page 1201

(*i.e.* , a pin as part of the clip protruding through the splash guard) broadly as an "idea" or "conception" (screwing a bolt into threads) that the district court viewed as being old in the prior art. Such treatment emasculates a real difference in this case between the claimed invention and the prior art.

(2) Level of Ordinary Skill

The *Graham* analysis includes a factual determination of the level of ordinary skill in the art. Without that information, a district court cannot properly assess obviousness because the critical question is whether a claimed invention would have been obvious at the time it was made to one with ordinary skill in the art.²⁶ The important consideration is "the need to adhere to the statute, *i.e.*, to hold that an invention would or would not have been obvious, as a whole, when it was made, to a person of 'ordinary skill in the art' -- not to the judge, or to a layman, or to those skilled in remote arts, or to geniuses in the art."²⁷

The person of ordinary skill is a hypothetical person who is presumed to be aware of all the pertinent prior art.²⁸ The actual inventor's skill is not determinative.²⁹ Factors that may be considered in determining level of skill include: type of problems encountered in art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.³⁰ Not all such factors may be present in every case, and one or more of them may predominate.³¹

In appropriate cases we have noted a district court's failure to make a specific, or correct, finding on level of skill, without the consequence of reversal.³² In those instances, however, it was not shown that the failure to make a finding or an incorrect finding on level of skill influenced the ultimate conclusion under section 103 and, hence, constituted reversible error.

In the present case, we do not reverse or vacate solely because of a failure to make the level of skill finding. We merely consider the district court's failure to make that and other *Graham* findings as evidence that *Graham* was not in fact applied.³³

(3) Objective Evidence of Nonobviousness

It is difficult for us to tell from the district court's discussion of commercial success (*see* discussion at section B, *supra*) whether there was a finding of commercial success and, if so, whether there was "nexus" between the commercial success and the claimed invention. Such nexus, the existence of which Jeffrey-Allan on appeal disputes, is needed if commercial success is to be considered.³⁴

Conclusion

If, on review of a determination of obviousness, an appellant shows that the district court incorrectly applied the law, we will not reverse (*i.e.*, hold that defendant below failed to prove obviousness) unless appellant also convinces us that a proper application of the law to the facts of record would change the result.³⁵ Sometimes, however, an appellant will convince us that the law was incorrectly applied, but there are inadequate findings by the district court to enable us to determine independently whether defendant below did or did not prove that the invention would have been obvious. That has happened here because, as explained above, there are inadequate findings in a number of regards. In such circumstances, rather than find material facts ourselves, we must remand to allow the district court to do so. As stated in *Icicle Seafoods, Inc. v. Worthington*:³⁶

If the Court of Appeals believed that the District Court had failed to make findings

Page 1202

of fact essential to a proper resolution of the legal question, it should have remanded to the District Court to make those findings. If it was of the view that the findings of the District Court were "clearly erroneous" within the meaning of Rule 52(a), it could have set them aside on that basis. If it believed that the District Court's factual findings were unassailable, but that the proper rule of law was misapplied to those findings, it could have reversed the District Court's judgment. But it should not simply have made factual findings on its own.

Hence, we vacate the judgment of the district court and remand for further proceedings. The district court, based on the record before it and in light of the guidance provided herein, is instructed (1) to make proper findings underlying a determination under section 103, sufficient for us to review its judgment and to assure us that the *Graham* test was in fact applied, and (2) to determine whether defendant below has carried its burden of showing by clear and convincing evidence that the claimed invention would have been obvious under section 103. If the district court deems it appropriate, it may elicit new evidence.

On remand, the district court should also address the other issues presented, *e.g.*, "overclaiming," the section 102(f) defense, and infringement, and should enter judgment accordingly. That way, we need not remand the case should we reverse the district court, in a future appeal, on, *e.g.*, a determination of obviousness. Too often, district courts resolve only one of a number of issues presented and, when reversed on that issue, are forced to retry the remainder of the case. Such retrial is, on balance, an inefficient use of the judicial process. It can, for example, involve duplication of much of the testimony and evidence presented at the first trial.³⁷

VACATED AND REMANDED

Footnotes

Footnote 1. The Memorandum and Order actually concluded that the use of Custom's "anchoring means rather than another in an old combination was * * * obvious." We presume the district court implicitly concluded that the inventions claimed by claims 1 and 6 would have been obvious.

Footnote 2. *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

Footnote 3. See *Bausch & Lomb, Inc. v. Barnes-Hind Hydrocurve, Inc.*, 796 F.2d 443, 447, 230 USPQ 416, 421 (Fed. Cir. 1986); *Loctite Corp. v. Ultraseal, Ltd.*, 781 F.2d 861, 872, 228 USPQ 90, 97-98 (Fed. Cir. 1986); *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163, 225 USPQ 34, 37 (Fed. Cir. 1985).

Footnote 4. Cf. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1540, 218 USPQ 871, 880 (Fed. Cir. 1983) (a trial judge's "reference to 'the hear of invention' was * * * a * * * fall-back to the fruitless search for an inherently amorphous concept that was rendered unnecessary by the statute, 35 U.S.C. The *Graham* analysis here applied properly looked to *patentability*, not to 'invention!'" (Emphasis in original.)).

Footnote 5. *Fromson v. Advance Offset Plate, Inc.*, 755 F.2d 1549, 1556, 225 USPQ 26, 31 (Fed. Cir. 1985).

Footnote 6. *Stratoflex*, 713 F.2d at 1540, 218 USPQ at 880.

Footnote 7. *Fromson*, 755 F.2d at 1556, 225 USPQ at 31 (emphasis in original), quoting *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1462, 221 USPQ 481, 488 (Fed. Cir. 1984); see also *In re Deminski*, 796 F.2d 436, 442, 230 USPQ 313, 315-16 (Fed. Cir. 1986).

Footnote 8. See, e.g., *Gardner v. TEC Sys., Inc.*, 725 F.2d 1338, 1349-50, 220 USPQ 777, 786 (Fed. Cir.) (in banc), cert. denied, 105 S. Ct. 116 (1984); *Stratoflex*, 713 F.2d at 1540, 218 USPQ at 880.

Footnote 9. *Stratoflex*, 713 F.2d at 1540, 218 USPQ at 880.

Footnote 10. *Dual Mfg. & Eng'g, Inc. v. Burris Indus., Inc.*, 619 F.2d 660, 205 USPQ 1157 (7th Cir.) (in banc), cert. denied, 449 U.S. 870 [207 USPQ 1064] (1980).

Footnote 11. *Republic Inds., Inc. v. Schlage Lock Co.*, 592 F.2d 963, 100 USPQ 769 (7th Cir. 1979).

Footnote 12. Finding that an invention is an "improvement" is not a prerequisite to patentability. It is possible for an invention to be less effective than existing devices but nevertheless meet the statutory criteria for patentability.

Footnote 13. *Pentec, Inc. v. Graphic Controls Corp.*, 776 F.2d 309, 316-17, 227 USPQ 766, 770-71 (Fcd. Cir. 1985); see also *Windsurfing Int'l, Inc. v. AMF Incorporated*, 782 F.2d 995, 1000, 228 USPQ 562, 565 (Fed. Cir.), cert. denied, 106 S. Ct. 3275 (1986).

Footnote 14. *Loctite*, 781 F.2d at 873, 228 USPQ at 98; *Bausch & Lomb*, 796 F.2d at 450, 230 USPQ at 420; see also *Simmons Fastener Corp. v. Illinois Tool Works*, 739 F.2d 1572, 1575, 222 USPQ 744, 746 (Fed. Cir. 1984), cert. denied, 105 S. Ct. 2138 (1985).

Footnote 15. *Pentec*, 776 F.2d at 315, 227 USPQ at 770; *W. L. Gore & Assocs., Inc. v.*

Garlock, Inc., 721 F.2d 1540, 1555, 220 USPQ 303, 314 (Fed. Cir. 1983); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 895; 221 USPQ 669, 675 (Fed. Cir. 1984).

Footnote 16. See, e.g., *Leinoff v. Louis Milona & Sons, Inc.*, 726 F.2d 734, 740, 220 USPQ 845, 849 (Fed. Cir. 1984).

Footnote 17. *Medtronic, Inc. v. Intermedics, Inc.*, 799 F.2d 734, 739, 230 USPQ 641, 643 (Fed. Cir. 1986).

Footnote 18. *Dual Mfg.*, 619 F.2d at 666, 205 USPQ at 1164; *Republic Indus.*, 592 F.2d at 975, 200 USPQ at 777. In *Stratoflex*, 713 F.2d at 1539, 218 USPQ at 879, this court expressly rejected that notion as circular reasoning.

Footnote 19. *Loctite*, 781 F.2d at 872, 228 USPQ at 97; *SSIH Equip., S.A. v. USITC*, 718 F.2d 365, 375, 218 USPQ 678, 687 (Fed. Cir. 1983).

Footnote 20. Anticipation is a consideration under 35 U.S.C. §102, which states in subsection (a) that a person is not entitled to a patent if the invention was "patented or described in a printed publication." A reference "anticipates" when it includes each element of the claimed invention. Section 102 of 35 U.S.C. was not applied by the district court as a ground for invalidating claims 1 and 6.

Footnote 21. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1139, 227 USPQ 543, 548 (Fed. Cir. 1985) (quoting *Fromson*, 755 F.2d at 1555, 225 USPQ at 31).

Footnote 22. *Accord American Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1364, 220 USPQ 763, 774 (Fed. Cir.), cert. denied, 105 S. Ct. 95 [224 USPQ 520] (1984) (upon reissue in light of prior art before the district court, the "burden of proof of unpatentability has become more difficult to sustain").

Footnote 23. *Loctite*, 781 F.2d at 873, 228 USPQ at 98.

Footnote 24. Id.

Footnote 25. Id.; *Jones v. Hardy*, 727 F.2d 1524, 1529, 220 USPQ 1021, 1025 (Fed. Cir. 1984).

Footnote 26. *Stratoflex*, 713 F.2d at 1538, 218 USPQ at 878-79.

Footnote 27. *Environmental Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 697, 218 USPQ 865, 868-69 (Fed. Cir. 1983), cert. denied, 464 U.S. 1043 [224 USPQ 520] (1984).

Footnote 28. See, e.g., *Standard Oil Co. v. American Cyanamid Co.*, 774 F.2d 448, 454, 227 USPQ 293, 297 (Fed. Cir. 1985).

Footnote 29. Id.

Footnote 30. *Environmental Designs*, 713 F.2d at 696, 218 USPQ at 868.

Footnote 31. Id.

Footnote 32. See, e.g., *Kloster Speedsteel AB v. Crucible, Inc.*, 793 F.2d 1565, 1574, 230 USPQ 81, 86 (Fed. Cir. 1986); *Union Carbide Corp. v. American Can Co.*, 724 F.2d 1567, 1573, 220 USPQ 584, 589 (Fed. Cir. 1984); *Chore-Time Equip., Inc. v. Cumberland*, 713 F.2d 774, 779, 218 USPQ 673, 676 (Fed. Cir. 1983).

Footnote 33. In *Chore-Time* and *Union Carbide*, this court noted that the prior art itself reflects an appropriate level of skill. See also *Litton Indus.*, 755 F.2d at 163-64, 225 USPQ at 38. In the present case, the district court made no similar notation.

Footnote 34. *Cable Elec. Prods., Inc. v. Genmark, Inc.*, 770 F.2d 1015, 1026, 226 USPQ 881, 887 (Fed. Cir. 1985).

Footnote 35. See, e.g., *Carella v. Starlight Archery & Proline Co.*, No. 86-728, sl. op. at Copyright 2006, The Bureau of National Affairs, Inc. Reproduction or redistribution, in whole or in part, and in any form, without express written permission, is prohibited except as permitted by the BNA Copyright Policy. <http://www.bna.com/corp/index.html#V>

10 [231 USPQ 644] (Fed. Cir., Oct. 22, 1986); *Union Carbide*, 724 F.2d at 1523, 220 USPQ at 589.

Footnote 36. *Icicle Seafoods, Inc. v. Worthington*, 106 S.Ct. 1527, 1530 (1986).

Footnote 37. See, e.g., *Stratoflex*, 713 F.2d at 1540-41, 218 USPQ at 880.

- End of Case -

EXHIBIT F

**ARMAMENT SYSTEMS AND PROCEDURES, INC., Plaintiff-Appellee, v.
MONADNOCK LIFETIME PRODUCTS, INC. and CASCO INTERNATIONAL,
INC., Defendants-Appellants.**

97-1174

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

1998 U.S. App. LEXIS 20818

August 7, 1998, Decided

NOTICE: [*1] RULES OF THE FEDERAL CIRCUIT COURT OF APPEALS MAY LIMIT CITATION TO UNPUBLISHED OPINIONS. PLEASE REFER TO THE RULES OF THE UNITED STATES COURT OF APPEALS FOR THIS CIRCUIT.

SUBSEQUENT HISTORY: Rehearing Denied September 2, 1998, Reported at: *1998 U.S. App. LEXIS 24605*. Reported in Table Case Format at: *1998 U.S. App. LEXIS 38044*.

DISPOSITION: Affirmed.

JUDGES: Before MAYER, Chief Judge, RADER, and BRYSON, Circuit Judges.

OPINIONBY: BRYSON

OPINION: BRYSON, Circuit Judge.

Appellee Armament Systems and Procedures, Inc., (ASP) brought suit against appellants Monadnock Lifetime Products, Inc., and Casco International, Inc., (collectively Monadnock) for patent infringement. Following a jury trial, the United States District Court for the Eastern District of Wisconsin entered judgment in favor of ASP on one of the two patents in suit. Monadnock appeals, contending that the district court erred in construing critical claim language and that the claims on which liability was based were obvious in light of the prior art. We affirm.

I

Both ASP and Monadnock manufacture expandable police batons. The batons are designed to serve as medium force weapons that can easily be carried by police officers. Consisting of several telescoping segments, the batons can be extended to make a lightweight steel rod

that can be used to control suspects without inflicting [*2] serious injury.

ASP obtained two patents relating to expandable police batons. The first patent to issue was U.S. Patent No. 5,110,375 (the '375 patent), a process patent covering the process for making the baton. The second to issue was U.S. Patent No. 5,348,297 (the '297 patent), a product patent covering the baton itself. ASP then filed a complaint charging Monadnock with infringing both patents. With the consent of the parties, the district court first held a bench trial on claim construction and validity. At the conclusion of that trial, the court announced its construction of the claims at issue and held that both the '375 patent and the '297 patent were not invalid. Subsequently, a jury heard the parties' evidence on the issue of infringement. The jury found that Monadnock had infringed both patents, but that the infringement was not willful. The court later vacated the jury's verdict of infringement with respect to the '375 patent, but upheld the verdict on the '297 patent. The court then entered an injunction and awarded damages in the amount of \$ 1,235,176. Monadnock appeals from that judgment.

II

Monadnock alleges two errors in the district court's construction [*3] of claim 1 of the '297 patent. First, Monadnock argues that a proper construction of the claim should include certain specific process limitations that appear in the specification. Second, Monadnock contends that the district judge misconstrued the term "annealed" as used in the claim. We address each of these contentions in turn.

A

Claim 1 of the '297 patent contains a preamble and various limitations describing the physical characteristics of the baton. Monadnock admits that its batons satisfy all

of the physical limitations, so the dispute focuses on the preamble to the claim. In pertinent part, Claim 1 reads as follows:

An expandable baton formed of an annealed material and subsequently heat treated after forming for strengthening the baton for use as an impact intermediate force weapon,

Monadnock argues that this claim language must be read to incorporate a four-step process for manufacturing the baton that is set out in the written description portion of the patent. The Summary of the Invention of the '297 patent provides the following:

The present invention provides a method for manufacturing an expandable baton which provides a strong yet easily manufactured [*4] baton. The method of this invention comprises the following steps. The first step is forming heat treatable alloy steel into a main section and a telescoping section. The second step is annealing the main section and the telescoping section by heat treating. After annealing the main section and the telescoping section, the next step is forming a portion of a joint on both the main and telescoping sections such that the joint portions on the main and telescoping sections form a complete joint when the baton is in an extended position. After forming the joint, the last step is hardening the main and telescoping sections by heat treating.

Monadnock argues that even though claim 1 does not recite the four-step process laid out in the Summary of the Invention, the claim should be construed to include that process as a limitation. If Monadnock's claim construction argument is correct, it was entitled to prevail on the issue of literal infringement, since the evidence at trial showed that Monadnock's batons are not manufactured in strict accordance with the four-step sequence. In particular, the evidence showed that Monadnock's steel is heat treated before it is cut into main and telescoping [*5] sections, thereby reversing the first and second steps described in the specification.

We agree with the district court that the ordered four steps of the process described in the Summary of the Invention should not be construed as a limitation of claim 1 of the '297 patent. Claim interpretation is the process of giving proper meaning to claim language. See *York Prods., Inc. v. Central Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1572, 40 U.S.P.Q.2D (BNA) 1619, 1622 (Fed. Cir. 1996). While consideration of the entire public record surrounding a patent is necessary in construing disputed claim language, "the language of the claim frames and ultimately resolves all issues of claim interpretation." *AbTox, Inc. v. Exitron Corp.*, 122 F.3d 1019, 1023, 43 U.S.P.Q.2D (BNA) 1545, 1548 (Fed. Cir. 1997); *Thermalloy, Inc. v. Aavid Eng'g, Inc.*, 121 F.3d

691, 692, 43 U.S.P.Q.2D (BNA) 1846, 1848 (Fed. Cir. 1997). Accordingly, a proposed claim limitation must find some textual support within the claim itself.

That principle is fatal to Monadnock's argument. Claim 1 includes certain process limitations in the preamble, but those process limitations are quite different from the ones in the Summary of the Invention. The [*6] preamble specifically lists two process steps: forming and subsequent heat treating. The requirement that those two steps be performed on "an annealed material" indicates that an annealing step must precede both forming and heat treating. There are no words anywhere in the claim, however, that specify a cutting step or dictate when the cutting step must occur. Without any textual basis, we cannot "interpret" the claim in the manner suggested by Monadnock. See *Hoganas AB v. Dresser Indus., Inc.*, 9 F.3d 948, 950, 28 U.S.P.Q.2D (BNA) 1936, 1938 (Fed. Cir. 1993) ("It is improper for a court to add 'extraneous' limitations to a claim, that is, limitations added 'wholly apart from any need to interpret what the patentee meant by particular words or phrases in the claim.'") (citations omitted).

The fact that all four process steps are clearly set out in the specification of the '297 patent is unavailing to Monadnock. Limitations that appear only in the specification may not be read into patent claims. See *Electro Med. Sys., S.A. v. Cooper Life Sciences, Inc.*, 34 F.3d 1048, 1054, 32 U.S.P.Q.2D (BNA) 1017, 1021 (Fed. Cir. 1994); *Intervet Am., Inc. v. Kee-Vet Labs., Inc.*, 887 F.2d 1050, 1053, 12 U.S.P.Q.2D (BNA) [*7] 1474, 1476 (Fed. Cir. 1989) ("Interpreting what is meant by a word in a claim 'is not to be confused with adding an extraneous limitation appearing in the specification, which is improper.'") (citation omitted). In this case, because ASP originally filed a single patent application, the '297 product patent and the '375 process patent share a common specification. The district court found that the claims of the '375 patent require that each of the four steps be performed and that they be performed in a specific order. That does not imply, however, that all of the process limitations described in the specification must be read into the claims of the '297 patent in the absence of textual support.

Monadnock next argues that the prosecution history requires that the four-step process be read into claim 1 of the '297 patent. Again, we disagree. As an initial matter, any argument based on prosecution history must fail for the same reason as the specification argument: lack of textual support in the claim. Prosecution history may not be used to "enlarge, diminish or vary" the scope of a patent claim. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 980, 34 U.S.P.Q.2D (BNA) [*8] 1,321 (Fed. Cir. 1995) (in banc), aff'd, 517 U.S. 370, 38 U.S.P.Q.2D (BNA) 1461, 134 L. Ed. 2d 577, 116 S. Ct. 1384 (1996).

Accordingly, statements appearing in the file history of the patent are not sufficient to add entirely new limitations to a claim. See *Serrano v. Telular Corp.*, 111 F.3d 1578, 1584, 42 U.S.P.Q.2D (BNA) 1538, 1542-43 (Fed. Cir. 1997).

In any event, we disagree that the cited prosecution history excerpts indicate that ASP limited the claims of the '297 patent to the specific four-step process set forth in the Summary of the Invention. The inventor, ASP principal Kevin Parsons, made references in the course of the prosecution history to the process used to produce the claimed baton, but none of the statements to which Monadnock points us commits ASP to the position that the step of cutting the tubing into sections before annealing is a limitation of the product patent claims.

To be sure, the prosecution history makes clear that the product claims have process limitations. But the process limitations referred to are those explicitly found in the claims, i.e., that the baton must be made of annealed material and subsequently heat treated after forming. In none of [*9] the excerpts from the prosecution history to which Monadnock refers did Parsons suggest that the order in which the tube sections are cut and annealed is a necessary part of the product claim. For instance, Parsons argued at one point that the baton could not be made by a "materially different" process. The evidence at trial, however, suggested that "one may be able to cut the tubing at different points in the process without, as a practical matter, changing how the process works."

In the course of the prosecution, Parsons sought to distinguish a prior art reference, a martial arts baton known as the "Imada Keibo," on the ground that it did not teach "the exact heat treating method or . . . performance of the heat treating after the baton sections have been formed." That remark, however, related to the use of the two-step heat treating method set forth in the claim (annealing, followed by heat treating) and to the use of a final heat treating step after formation of the baton sections. It did not refer to the order of cutting the baton sections vis-a-vis the annealing step.

In a reissue application filed in connection with the '375 process patent, Parsons explicitly stated that [*10] to give the baton the required strength and durability, it was necessary to follow the four steps recited in the claims of the reissue application, including the step of cutting the tube into segments before annealing. Monadnock argues that the assertions during the reissue proceedings should be used to construe the claims of the product patent, and that the product claims should therefore be construed to include as limitations the four steps set forth in the process claims.

The trial court rejected Monadnock's argument on that point, and properly so. The effect of including the four-step process in the process patent claims and stating that those steps were critical to the claimed process for producing the subject baton was to make the process claims significantly narrower than the product claims. Indeed, it was because of the prosecution history of the process claims that the trial court held that Monadnock's batons did not infringe the '375 patent under the doctrine of equivalents. But the prosecution history on which Monadnock relies does not shed light on the scope of the claims of the product patent, which were properly construed as not requiring that the claimed batons be made [*11] by the particular four-step process that was referred to in the common specification and specifically included in the process patent claims. In that respect, the process patent was properly construed as narrower than the product patent, even though the two patents share a common ancestry.

Finally, Monadnock argues that a statement made by ASP at an earlier stage of this litigation requires that claim 1 of the '297 patent be construed to include the four-step process in the specification. The statement in question was made by ASP in a motion for summary judgment on the issue of the validity of both the '375 and the '297 patents. Referring to the Imada Keibo prior art baton, ASP argued that Imada "does not teach the process steps or the specific order of steps of the patents in issue. . . . The order of steps of a) forming the tubing from 4130 heat treatable alloy steel; b) annealing the tubing; c) forming the joints; and d) heat treating for strengthening is required by the claims of the '297 and '375 patents."

Monadnock construes that statement to be an explicit admission by ASP that the tubing must be cut before annealing, but it is clear that ASP did not adopt that position. [*12] Throughout the validity phase of the litigation, ASP consistently argued that the first step of the four-step process described in the specification referred only to the process of cold-drawing stock 4130 steel to meet ASP's specification for tubing used in the batons, not to cutting the tubing into main and telescoping sections. The excerpt from the summary judgment motion cited by Monadnock is consistent with that position. In his opinion on claim construction and validity, the district judge rejected that interpretation, finding instead that the '375 patent required actual cutting of the cold-drawn tubing before annealing, not just formation. Because ASP did not argue at the validity stage that the '297 patent required that the tubes be cut into sections before annealing, it was free to argue at the infringement stage that that aspect of the four-step process of the specification is not incorporated into the pertinent claim.

B

Monadnock's second argument is that the district court improperly construed the term "annealed material," as used in claim 1 of the '297 patent, and improperly instructed the jury on that issue. Monadnock does not take issue with the court's interpretation [*13] of the term "material" as meaning "alloy steel," but instead focuses on the court's interpretation of the term "annealed." According to Monadnock, the district court defined the term "anneal" disjunctively, to refer to a heating process that either softens steel or makes it more formable; that disjunctive definition, Monadnock argues, was erroneous and misled the jury. Monadnock asserts that the term "anneal," as used in claim 1 of the '297 patent, "can only mean 'soften to make more formable' and not 'soften or make more formable.'"

The main problem with Monadnock's argument is that the instruction that the court gave to the jury with respect to the use of the term "anneal" in the '297 patent is entirely consistent with the definition for which Monadnock argues. Although Monadnock believed that the court was going to instruct the jury that annealing could include "softening" steel or making it more formable, the court did not give such an instruction, but instead instructed the jury as follows, with respect to the '297 patent:

Now what is annealed steel? Annealed steel is a steel that is heat treated and softened to increase the formability relative to its cold drawn [*14] or as drawn condition, so that one can more easily form swages and flares without cracking or introducing stress.

That instruction effectively defined the term "annealed" steel as steel that has been both softened and made more formable relative to its cold drawn condition, which is essentially the definition that Monadnock argues should have been given.

Subsequently, in connection with its instructions on the '375 patent, the district court referred to annealing by using the phrase "softens or increases the formability of the material." But that instruction, which related to a patent on which Monadnock was not held liable, is not directly relevant here. It is the instruction on the '297 patent that is critical for purposes of this appeal. Moreover, no objection was made to the instructions as given, even though the inconsistency was in the written proposed instructions that were given to the lawyers prior to the instruction conference and were given to the jury during its deliberations. Having received an instruction that was consistent with its current theory of the case, Monadnock cannot now complain that it was prejudiced because a different instruction was given [*15] with respect to a different patent, at least where Monadnock

did not point out the inconsistency to the court by way of a timely objection at trial.

The definition given with respect to the '297 patent is also entirely consistent with the usage of the term annealed in the patent specification. The specification describes the function of annealing the baton sections as "softening the tubing and allowing the swages and flares to be easily formed without cracking or introducing stress." Thus, annealing solves two problems in joint formation identified in the prior art: the difficulty and tooling wear associated with machining harder steel, and the problem of cracking when rigid steel is deformed into swages and flares. The jury heard conflicting evidence from ASP's and Monadnock's respective experts on whether Monadnock's steel satisfied that definition of "annealed." Although Monadnock's expert made a persuasive case that the steel used in Monadnock's baton was not softer than in the as-drawn condition, we cannot say that the jury's verdict to the contrary was unsupported by substantial evidence. ASP's expert testified that he had conducted tests that showed that Monadnock's steel [*16] would be softer after heat treatment. The jury was entitled to credit that testimony over the competing views of Monadnock's expert in reaching its verdict.

On the instruction issue, Monadnock makes the further contention that the trial court should have instructed the jury that metal is not annealed unless it is softened to below a rating of 103 on the Rockwell B hardness scale, a widely used measure of hardness in steel. It was proper for the court to refuse to define annealing with respect to a particular Rockwell hardness standard, because the term was used in the patent without any such specificity; the patent referred to annealing simply as a process that "softens the tubing and allows the swages and flares to be easily formed without cracking or introducing stress."

III

Monadnock's final argument is that claim 1 of the '297 patent should have been held invalid for obviousness. Obviousness is a legal conclusion based on subsidiary factual findings that include the scope and content of the prior art, the level of ordinary skill in the prior art at the time of the invention, objective evidence of nonobviousness, and the differences between the prior art and the claimed [*17] subject matter. See *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 15 L. Ed. 2d 545, 86 S. Ct. 684 (1966). Monadnock argues, first, that the district court erred in characterizing the pertinent art as baton-making rather than metallurgy and that the invention would have been obvious to a metallurgist of ordinary skill. Second, Monadnock contends that the Imada Keibo martial arts baton and an instruction manual describing that baton, which were in the prior art, rendered claim 1

of the '297 patent obvious and that the district court should have held that claim invalid on that ground.

A

The district court found that the pertinent art for purposes of the '297 patent was baton-making, not metallurgy. That determination is important because it establishes the frame of reference for analyzing obviousness from the perspective of a person of ordinary skill in the art. The issue of what constitutes the pertinent art is an issue of fact. See *Shatterproof Glass Corp. v. Libbey-Owens Ford Co.*, 758 F.2d 613, 620, 225 U.S.P.Q. (BNA) 634, 637-38 (Fed. Cir. 1985). The district court's resolution of that question therefore must be upheld unless it is clearly erroneous. While we regard the question [*18] as a close one, we are unable to conclude that the district court committed clear error in defining the pertinent art as baton-making rather than metallurgy.

The pertinent field of art relating to the patented subject matter is determined by the nature of the problem confronting the inventor. See *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1009, 217 U.S.P.Q. (BNA) 193, 196 (Fed. Cir. 1983). Several factors may illuminate that inquiry, including an examination of the type of skills needed to understand the patent disclosure, the type of art applied to the application in the Patent and Trademark Office, and the areas of expertise of witnesses who are recruited to testify concerning the obviousness of the invention. See *id. at 1008-10*. Having reviewed the record in this case, we believe it was reasonable for the district court to conclude that baton-making was the relevant field of art.

Initially, it is clear that the problem that Parsons set out to solve with his invention related specifically to baton manufacturing. Prior art expandable batons had suffered from failures due to bending and distortion at the joints. The record of prior art solutions and Parsons' own failed [*19] attempts demonstrate that metallurgy was not the exclusive field to which baton designers looked in attempting to remedy the problem. Various tooling processes and mechanical reinforcement techniques were also employed. That evidence supports the district court's conclusion that baton-making is a discrete field of art rather than simply a field of commercial application for metallurgical inventions. See *id. at 1008*.

The type of art cited by the Patent and Trademark Office in the prosecution of Parsons' application also argues against defining the pertinent field as metallurgy. References cited against Parsons included martial arts batons, police batons, and expandable fish knockers, as well as the basic metallurgy texts that Monadnock relies on to support its position.

Monadnock argues that the use of metallurgy experts during patent prosecution and in the validity and infringement trials demonstrates that metallurgy is the pertinent field of art. While we agree that the use of experts in a certain field to testify may be probative, the relevant inquiry for obviousness focuses on the time just before the invention was made. In many cases, the post-invention use of experts [*20] simply reflects the field that provided a successful solution to the problem that confronted the inventor, without representing the variety of available options before the invention was made.

Finally, the patent specification also suggests that the pertinent art is baton-making rather than metallurgy. The descriptions of the invention and of the prior art are directed specifically at batons. The discussion of metallurgy is basic and functionally oriented. It reflects none of the subtlety and careful distinction between varying types of heat treatments that were the focus of attention at trial. The district court also found, based on ample evidence, that tactical police batons are designed by baton-makers, not metallurgists. As a result, the district court was justified in concluding that the relevant art was baton-making and that a person of ordinary skill in the art would be familiar with the rudiments of metallurgy and other techniques that had previously been applied to baton manufacture. In light of the applicable standard of review, we are not persuaded that the court committed reversible error on that issue.

B

We also are not persuaded by Monadnock's argument that [*21] the prior art Imada Keibo baton and its accompanying instruction manual rendered the claimed invention obvious in light of basic metalworking knowledge. The district court identified the Imada Keibo as the most pertinent prior art and found that the Imada Keibo was made from the same type of heat-treatable alloy steel that was used in the claimed invention. The information regarding the Imada Keibo was submitted to the Patent and Trademark Office during prosecution of the '297 and '375 patent applications, but was dismissed by the examiner as vague.

Monadnock places its primary emphasis on an instructional manual accompanying the Imada Keibo. In pertinent part, the Imada baton was described as follows:

Each section was constructed of 4130 grade steel alloy (the strongest steel tubing available, with a normalized tensile strength of 90,000 PSI). It was further heat-treated to increase this strength to 125,000 - 140,000 PSI.

A common problem with other telescoping staffs on the market was the tendency for the center section to bend or open, thereby allowing the other sections to slip

out. For this reason, the center section of the Imada Keibo was noticeably thicker (0.83" wall thickness) [*22] than either the first or third sections. . . .

The Imada baton itself adds little to that description, because examination of the baton would not reveal the method of its manufacture. Monadnock argues that the Imada manual reveals a baton-making process that includes starting with heat treatable alloy steel, normalizing the steel, forming the joints, and then heat treating the completed tube segments. Monadnock notes that its accused batons use normalized 4130 grade steel and argues that if its batons infringe the '297 patent, then Imada must invalidate the patent for obviousness.

The district court scrutinized the Imada Keibo reference to determine the differences between that reference and the invention. Contrary to Monadnock's interpretation, the district court found as a factual matter that the Imada reference "adds heat treatment and alloy steel to the prior art," but that "it is silent on when to form the joints and on the annealing step."

Although the Imada reference is susceptible to competing interpretations, we discern no clear error in the district court's findings concerning the differences between the Imada reference and the invention. The first paragraph of the [*23] Imada instruction manual is directed to achieving a strong baton. Imada discloses that this may be accomplished by using 4130 grade steel, described as "the strongest steel tubing available," and by heat treating it to further increase its strength. Imada also describes the 4130 steel as having a "normalized" tensile strength of 90,000 PSI, but it is unclear whether the term "normalized" as used in the Imada manual refers to the heat treated condition of the steel used in the baton or whether it indicates that the reported tensile strength has been standardized to facilitate comparison with other materials without regard to specific tube dimensions. The Imada reference also discloses nothing about the virtues of softening the steel before forming to avoid processing difficulties. Moreover, Parsons testified that the Imada baton broke after several test blows, indicating that it was still insufficiently strong to serve as a workable model for intermediate impact force weapons for police officers.

Although Monadnock focuses on specific language in the Imada reference manual, a reference must be considered as a whole, including the portions that argue against or teach away from the claimed [*24] invention. See *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, 796 F.2d 443, 448, 230 U.S.P.Q. (BNA) 416, 420 (Fed. Cir. 1986). A reference teaches away from an invention when a person of ordinary skill "would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley*, 27 F.3d 551, 553, 31

U.S.P.Q.2D (BNA) 1130, 1131 (Fed. Cir. 1994). Aside from the apparent inoperability of the Imada baton for law enforcement purposes, the Imada reference indicates that the critical problem of joint wear and bending can be overcome by using thicker steel to construct the middle telescoping tube. The reference therefore suggests a different solution than the one eventually discovered by Parsons, which included using a heat treatable steel, annealing the steel before forming to more easily form a closely fitting taper lock between sections, and subsequently heating and quenching to produce a strong and durable baton.

Beyond that evidence, the court relied heavily on objective evidence of non-obviousness. The record reflects that the commercial embodiment of the claimed invention experienced immediate and substantial commercial success in the law enforcement community. Moreover, [*25] the court found, with evidentiary support, that Monadnock and another baton manufacturer had copied the claimed invention. Those factors buttress the district court's findings regarding the distinctions between the Imada Keibo baton and the baton recited in the '297 patent. We also note that the long history of attempts within the baton industry to solve the problem of joint failure was entitled to evidentiary weight in the determination of non-obviousness. See *Micro Chem., Inc. v. Great Plains Chem. Co.*, 103 F.3d 1538, 1547, 41 U.S.P.Q.2D (BNA) 1238, 1245 (Fed. Cir.), cert. denied, 138 L. Ed. 2d 1018, 117 S. Ct. 2516 (1997). It appears from the record that the problem solved by the ASP baton was well known and that the utility of a baton that would avoid those problems was equally well recognized. Although Parsons' solution to the problem may appear obvious with the benefit of hindsight, it represented a solution to a long-felt need and has quickly been adopted by its intended audience.

Monadnock argues that the commercial success of the ASP baton does not support ASP on the obviousness issue because there was no evidence that the commercial success was traceable to the patented [*26] features of the claimed invention. To the contrary, the district court concluded that prior art devices, unlike the ASP baton, were insufficient for law enforcement purposes because they could not "withstand the strain needed for an intermediate impact weapon." Because the '297 patent disclosed a stronger baton than was previously available, it was reasonable for the court to infer that the commercial success of the ASP baton was attributable to its structure and to the process by which it was made. In sum, in light of the district court's subsidiary factual findings bearing on the issue of obviousness, we uphold the court's ultimate legal conclusion that the claimed invention would not have been obvious in light of the Imada Keibo baton.

and the information available about the process by which that baton was manufactured.

IV

The trial record reveals that this was a close case, in which Monadnock put on a substantial defense, including detailed testimony from a highly qualified expert witness. On the obviousness issue, however, the district court carefully analyzed the evidence and found that

Monadnock had not met its high burden of showing, by clear and convincing evidence, that [*27] ASP's invention would have been obvious. And on the infringement issues, the jury was offered evidence of infringement, including testimony from ASP's expert, who disagreed with Monadnock's witness on several critical points. We are unable to say that the evidence on which the jury relied was insufficient to support the verdict. We therefore affirm the judgment.

EXHIBIT G

FULL TEXT OF CASES (USPQ FIRST SERIES)

Orthopedic Equipment Company, Inc. et al. v. United States

(CA FC)
217 USPQ 193
Decided Mar. 11, 1983
No. 250-77
U.S. Court of Appeals Federal Circuit

Headnotes

PATENTS

1. Patentability — Invention — In general (§ 51.501)

Traditional test, enunciated in *Graham v. John Deere Co.*, 148 USPQ 459, for Section 103 nonobviousness requires factfinder to make several determinations.

2. Patentability — Invention — In general (§ 51.501)

Nonobviousness of claims whose significant elements were well known in prior art as of time of patent's filing date arises only if they embody combination of those well-known elements that was not obvious to one of ordinary skill in art.

3. Patentability — Tests of — Skill of art (§ 51.707)

One factor bearing on determination of relevant art is type of skill required to understand patent's disclosure; beyond rudimentary knowledge of electromechanical devices, to understand disclosure of patent relating to information processing hardware one should be familiar with workings of information processing systems hardware.

4. Patentability — Tests of — Skill of art (§ 51.707)

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One of skill in art of designing information processing systems hardware would have been familiar with telephone line-switching technology.

5. Patentability — New use or function — Analogous art (§ 51.553)

Factor bearing on determination of relevant art is type of art applied to claims by PTO.

6. Patentability — New use or function — Analogous art (§ 51.553)

One looks to nature of problem confronting inventor in determining relevant art of claims in suit.

7. Patentability — New use or function — Analogous art (§ 51.553)

It is reasonable to expect that appellants who believed that specific art was relevant art would seek to rebut defendant's Section 103 charge of obviousness in second art by demonstrating nonobviousness of claims in that specific art.

8. Patentability — Tests of — Skill of art (§ 51.707)

Evidence adduced in support of Section 102 defenses can be probative on issue of level of skill in pertinent art even if it is inadequate to establish existence of Section 102 defense; in this regard, there is no distinction between Section 102(a) proofs and Section 102(g) proofs; moreover, Jacobson Bros., Inc. v. US, 185 USPQ 168, leaves no doubt about probativeness of prior art or educational backgrounds of those working in field.

9. Patentability — Anticipation — Knowledge of prior art presumed (§ 51.215)

Person of ordinary skill in art at time of patentee's invention is presumed to have before him all of relevant prior art.

10. Patentability — Anticipation — Combining references (§ 51.205)

It is wrong to use patent in suit as guide through maze of prior art references, combining right references in right way so as to achieve result of claims in suit; Monday morning quarterbacking is improper when resolving nonobviousness question in court of law.

11. Patentability — Anticipation — Combining references (§ 51.205)

Claims may be obvious in view of combination of references, even if features of one reference cannot be substituted physically into other reference's structure; what matters in Section 103 nonobviousness determination is whether person of ordinary skill in art, having all teachings of references before him, is able to produce structure defined by

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claim; fact that features of one reference cannot be substituted into second reference's structure may indicate that claims were nonobvious in view of combined teachings of two references; but this is not necessarily so; same can be said regarding complete mechanical misfit between two separate patented devices when combination is alleged to demonstrate obviousness of patent claims.

12. Patentability — Anticipation — Combining references (§ 51.205)

Fact that two disclosed apparatuses would not be combined by businessmen for economic reasons is not same as saying that it could not be done because skilled persons in art felt that there was some technological incompatibility that prevented their combination; only latter fact is telling on nonobviousness issue.

13. Patentability — Anticipation — Combining references (§ 51.205)**Patentability — Evidence of — In general (§ 51.451)****Patentability — Evidence of — Delay and failure of others to produce invention (§ 51.459)**

Failure of appellants to show existence of long-felt need for patented device amply explains why no businessman would undertake to literally combine two prior devices; however, this does not indicate any technological incompatibility between two prior art devices.

Particular patents — Business Information Systems

3,304,416, Wolf, Business Order Control Systems Apparatus, claims 1, 2, 6, and 7 invalid.

Case History and Disposition:

Page 194

Appeal from the United States Claims Court, Colaianni, Trial Judge; 212 USPQ 523 .

Petition by Orthopedic Equipment Company, Inc., and Marriott Corporation, against the United States, for compensation for use of an invention. From order dismissing petition, plaintiffs appeal and defendant cross-appeals. Affirmed; Nies, Circuit Judge, concurring with opinion.

See also 205 USPQ 483 .

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Attorneys:

William D. Hall, Potomac, Md. (Harry M. Saragovitz, Washington, D.C., on the brief) for appellants and cross-appellees.

Thomas J. Scott, Jr., Washington, D.C. (J. Paul McGrath, Thomas J. Byrnes, and Claud A. Daigle, Jr., on the brief) for appellee and cross-appellant.

Judge:

Before Markey, Chief Judge, and Davis, Nichols, Kashiwa, and Nies, Circuit Judges.

Opinion Text**Opinion By:**

Per curiam.

Both sides appeal from the judgment of the United States Claims Court * in this patent infringement suit. Appellants Orthopedic Equipment Company, Inc. (Orthopedic) and Marriott Corporation (Marriott), plaintiffs in the suit, brought this action pursuant to 28 U.S.C. § 1498 seeking compensation for the unauthorized manufacture or use by or for the United States of a nation-wide material handling system which is alleged to infringe claims 1, 2, 6, and 7 of United States Letters Patent No. 3,304,416 (the Wolf patent), entitled "Business Order Control System Apparatus." They filed administrative claims for compensation with several Department of Defense agencies for infringement of the Wolf Patent. The first of these administrative claims was filed in July 1976; none of the claims has ever been denied. The present suit was filed in the United States Court of Claims on May 6, 1977. Then Trial Judge Colaianni, after a trial, issued an opinion and findings holding that the invention set forth in claims 1, 2, 6 and 7 of the Wolf patent would have been obvious within the meaning of 35 U.S.C. § 103 and that the claims were therefore invalid. He either rejected or declined to pass upon other defenses raised by the United States. But he did decide that the plaintiffs were entitled to collect \$1,181.25 as part of the reasonable and necessary costs of a certain deposition. The final judgment was that, upon payment by the United States to the plaintiffs-appellants of \$1,181.25 as part of those deposition costs, the petition was to be dismissed. Plaintiffs appeal from the determination of invalidity, and defendant appeals from the award of deposition costs and also from the judge's failure to consider, or his rejection of, most of the Government's other defenses.

Because we agree with Judge Colaianni's reasons for his decision that the claims were invalid for obviousness, we confine our discussion of invalidity to those points and do not consider the United States' contentions that invalidity can be reached on other grounds. On the question of obviousness (Part I infra) our opinion incorporates, for the most part,

Judge Colaianni's opinion. We also consider (Part II infra) the issue of deposition costs.

I - Obviousness

Appellants accuse the appellee of infringing claims 1, 2, 6, and 7 of the patent in suit. Claims 1 and 2 are very similar to one another. Likewise, claims 6 and 7 are very similar to each other. The main differences between the claims are the differences which exist between these two similar groups. The parties agreed at trial to treat claims 2 and 7 as representative of their respective groups. This convention will also be followed in this

Page 195

opinion. However, should a peculiar aspect of either claim 1 or claim 6 affect the outcome of the determination of validity, then this fact will be emphasized.

The Claims

Wolf claims 2 and 7, presented in subparagraph form with the sequencing of the claim elements slightly rearranged from the sequencing found in the patent itself.¹ are as follows:

Claim 2

- (a)(1) An electrical system
 - (2) for controlling the operation of a business,
- (b)(1) comprising
- (c)(1) a plurality of order stations,
- (d)(1) means
 - (2) at each of said order stations
 - (3) for generating coded messages corresponding to the orders entered at said station,
- (e)(1) a central station
 - (2) connected for control in turn from any of said order stations,
- (f)(1) means
 - (2) for programming the operation of each order station to cause the transmission of the messages,
 - (3) in orderly fashion,
 - (4) to the central station,
- (g)(1) a plurality of work stations
 - (2) at which are to be performed respective items of work called for by said messages,
- (h)(1) means
 - (2) at said control station
 - (3) for recording the messages as received,
 - (4) and for computing numerical information
 - (5) based on the content of said messages,
- (i)(1) and means
 - (2) at each work station,
 - (3) responsive to the relayed message portions,
 - (4) for providing a visual display
 - (5) of order information pertinent to that work station.

Claim 7

- (a)(1) A remote control
 - (2) and computing
 - (3) system
 - (4) for mercantile operations
- (b)(1) comprising
 - (c)(1) work stations,
 - (d)(1) at least one order station,
 - (2) remote from said work stations,
 - (e)(1) and a central station;
 - (f)(1) remotely controllable
 - (2) order registering equipment
 - (3) at said central station
- (g)(1) means connecting
 - (2) said order station to said equipment
 - (3) to register therein signals representing items of work to be performed;
- (h)(1) automatic means
 - (2) associated with said central station
 - (3) for translating said signals into a registrable code
 - (4) and for appending thereto codes representative of each work item;
- (i)(1) and a calculator control
 - (2) led by said automatic means
 - (3) for registering the items of work and price data individual thereto
 - (4) and for computing said data to provide an output total;
- (j)(1) and means
 - (2) associated with said central station
 - (3) for transferring portions of said signals selectively to respective work stations
 - (4) to control the manifestation thereat of such work items for processing at said stations[,]
- (k)(1) apparatus
 - (2) at each work station
 - (3) for registering
 - (4) and intelligibly manifesting
 - (5) the items of work to be performed, as called for by said signals[.]

The Nonobvious Subject Matter**Requirement of 35 U.S.C. § 103**

[1] The traditional test, enunciated in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), for § 103 nonobviousness requires the factfinder to make several determinations. The test provides:

Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved need, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. [383 U.S. at 17-18, 148 USPQ at 467].

Scope and Content of the Prior Art Summarized

Much of the prior art in the trial record consists of United States Letters Patent which were considered by the Patent and Trademark Office (PTO) during the prosecution of the Wolf patent. These patents for the most part reside within the art of information processing system hardware. A number of them draw upon the technology found in telephone line-switching devices. The technology embodied in the information processing and telephone fields tends to evolve rapidly in response to prior and concurrent developments.

The individual patents themselves disclose one or more, but less than all, of the separate Wolf claim elements. Their combined teachings disclose all of the Wolf claim elements. Several of these patents each show how to combine two or more of the Wolf claim elements. They demonstrate the facility with which the various means identified in the Wolf claims can be made to interface with each other in order to form the desired information processing devices.

The Relevant Art of the Invention in Suit

[2][3] The claims in suit provide a convenient starting point for determining the relevant art. The significant claim elements which combine to form the claims in suit were well-known in the prior art as of the time of the Wolf filing date. Thus nonobviousness of these claims would arise only if they embody a combination of these well-known elements that was not obvious to one of ordinary skill in the art. One factor bearing on the determination of the relevant art is the type of skill required to understand the disclosure of the Wolf patent, which relates to information processing hardware. Beyond a rudimentary knowledge of electromechanical devices, one should be familiar with the workings of information processing systems hardware.

[4] One of skill in the art of designing information processing systems hardware at the time of the Wolf filing date would have been familiar with telephone line-switching technology. This conclusion is apparent from the Andrews-Vibbard² disclosure, the Gimpel³ disclosure, and is consistent with the fact that the technology used for the routing of signals in the early models of information processing systems hardware was borrowed from telephone line-switching technology.

[5] A second factor bearing on the determination of the relevant art is the type of art applied to the claims by the PTO. As already noted, much of this art deals with information processing systems hardware and telephone line-switching technology.

[6] In determining the relevant art of the claims in suit one looks to the nature of the problem confronting the inventor. *Weather Engineering Corp. of America v. United States*, 614 F.2d 281, 287, 204 USPQ 41, 46-47 (Ct. Cl. 1981). The appellants' expert, Copyright 2006, The Bureau of National Affairs, Inc. Reproduction or redistribution, in whole or in part, and in any form, without express written permission, is prohibited except as permitted by the BNA Copyright Policy. <http://www.bna.com/corp/index.html#V>

when asked to state the concept embodied in these claims that was not already present in the prior art as of the filing date of Wolf, said:

The concept of the message identifying an item of work being transmitted through a central station — or is transmitted to a central station, and then the use of the item identifier to route the message onto an appropriate work station with the ability, at the central station, to also perform numerical computations where the — at least some of the operands for that computation are also determined by the item description code entered at the work station, or — at the order station.⁴

In other words, appellants allege that one source of the patentability of the claims in suit is the way that the apparatus, as defined by the Wolf claims, uses the coded input information to make two separate types of decisions without the aid of direct human intervention at the time when the decisions are made. The first determination involves selecting price information from a data storage apparatus and appending the price information to the item input information. The Wolf system looks at the item code, and based on this code it is able to pick out the price of this item from the price information stored in the memory registers of the central station. It

Page 197

then associates this price information with the item code in all subsequent processing of the item input information. The hardware employed to perform this selection was well-known in the art of information processing systems hardware design as of the filing date of Wolf.

The second determination involves selecting the appropriate route for transmission of the coded input information to the proper work station, as well as to the calculator for numerical computations. The system's route selection is made depending upon the identity of the coded information. The hardware employed to perform this selection was well-known in the art of designing telephone line-switching hardware.

In view of the foregoing factors, it would seem that one can come no closer to pinpointing the relevant art of the Wolf claims than by choosing the art of information processing systems hardware. We conclude that the relevant art of the Wolf patent claims resides in the field of information processing systems hardware.

[7] Additional support for this conclusion comes from the fact that the appellants chose as their chief witness a person whose primary experience was in the computer hardware field,⁵ which is the major component of information processing systems hardware. Appellants' assertion of warehousing as the relevant art is unpersuasive. In defining the significance of the invention, appellants' chief witness, Mr. Nikolali, relied on his experience in the computer field, not on any expertise in the field of warehousing. In fact, Mr. Nikolai did not possess any expertise in the warehousing art, yet the appellants advanced his testimony in their rebuttal of the appellee's defense of invalidity for lack of nonobviousness of the Wolf claims. If the appellants truly believed that the relevant art was warehousing, it appears reasonable to expect that they would have sought to rebut the defendant's § 103 charge of obviousness in the art of information processing systems hardware by demonstrating the nonobviousness of the claims in the art of

warehousing. To do the latter appellants could not advance the testimony of Mr. Nikolai, who was totally unfamiliar with the warehousing art. However, the appellants' choice of Mr. Nikolai was not in fact ill-advised; their actions speak louder than their words in this instance, and their actions bolster the conclusion that the relevant art is in the field of information processing systems hardware.

Section 103 Defense Based on Nelson-Robinson and Andrews-Vibbard

The one of appellee's § 103 defenses that was accepted by the trial judge is based upon the combined teachings of two United States Letters Patents, Nos. 1,974,191 and 2,977,048.

United States Letters Patent No. 1,974,191 entitled, "Merchandise Control Systems," was filed by Martin L. Nelson and Harold C. Robinson on April 18, 1932 (the Nelson-Robinson patent). It was classified by the PTO in class 178, subclass 4, and issued on September 18, 1934. It was not considered by the PTO during the prosecution of the claims in suit.

The Nelson-Robinson apparatus includes both order stations and work stations. The work stations perform several functions, namely: credit checks, inventory record monitoring, and transaction documentation. Nelson-Robinson envisions a customer bringing merchandise he wants to purchase to a sales clerk at an order station. Attached to the merchandise is a merchandise display card which contains information coded as a pattern of perforations. The sales clerk operates a transmitter which receives the punched merchandise display card together with a sale clerk's card and a cashier's card, each of the three cards containing information in the form of punch codes. The transmitter in effect reads the punched information by completing certain circuits through the punched holes. Electric signals then activate various other devices at the work stations, depending upon the circuit connections made in the transmitter. A printing machine, located at the work station where the credit checks are made, prints out information pertinent to the sales transaction. A punch card machine, located at the inventory record room, punches out an inventory card for the purchased merchandise. Information concerning item description, quantity, and price is transmitted to appropriate adding machines which keep running totals of item quantities and dollar sales volume, and this information can be visually displayed on a printed page.

The Nelson-Robinson apparatus discloses all the elements of the claims in suit except the central station and certain elements associated with the central station. In Wolf's claim 2, for example, the Nelson-Robinson apparatus lacks elements (e), (f), and (h) (3). It also

Page 198

lacks elements (e), (f), (g), (h), (i) (3), and (j) (2) of Wolf's claim 7.

United States Letters Patent No. 2,977,048, entitled, "Automatic Calculator," was filed by Ernest G. Andrews and Edward L. Vibbard on December 17, 1946 (the Andrews-Vibbard patent). It was classified by the PTO in class 235, subclass 162. This is the same class as the Wolf patent, but a different subclass. Andrews-Vibbard issued on March 28, 1961, but was never considered by the Patent Office during the prosecution of

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the claims in suit.

The Andrews-Vibbard described apparatus is an electrical computing device of some sophistication which has provisions for storing results of intermediate calculations and later accessing those results for use as inputs for further calculations. The input information is coded onto perforated paper tapes. The type of calculation to be performed by the machine, and the timing of this performance in relation to other calculations, is controlled by a separate coded perforated tape called the master control tape. This tape contains the operating commands which permitted the apparatus to perform its basic addition and subtraction operations in a way that enabled it to do multiplication and division calculations, and ultimately to arrive at solutions to ballistic equations.

The Andrews-Vibbard apparatus, though not primarily a data storage or memory device, nonetheless did perform a limited storage function during the course of its calculation procedure. Moreover, as disclosed, the apparatus is capable of storing information on a paper tape for selection assessing by a computing device. The selection process was accomplished by means of telephone line-switching hardware, which Andrews-Vibbard teaches was well-known to those skilled in the art of early information processing systems hardware design. The patent in suit relies on an identical data storage arrangement for its price information. In addition, the Andrews-Vibbard apparatus satisfies all of the central station requirements of the claims in suit. The following claim 2 elements can be found in Andrews-Vibbard: (e), (f), (h), and (i). The following claim 7 elements can be found in Andrews-Vibbard: (e), (f), (g), (h), (i), and (j).

The claims in suit make considerable use of means language which reads broadly on the devices disclosed in the prior art. The structural elements or devices disclosed in the Wolf specification that perform the functions defined in the means portions of the claims were each well-known in the prior art at the time of the Wolf invention,⁶ as is amply demonstrated by Nelson-Robinson and Andrews-Vibbard. Thus, the patentability of the claims is not derived from the structural elements disclosed in the specification. The only difference between these references and the claims is that neither reference alone discloses the precise combination of elements claimed in the Wolf patent. Thus, the patentability of the claims must stem from the alleged fact that the specific combination of claim elements in Wolf was not disclosed in the prior art and the additional allegation that the specific combination of claim elements was nonobvious to one of ordinary skill in the art.

The appellants have argued that, not only would one of ordinary skill not know how to arrive at the claimed combination of elements, but that the appellee failed altogether to prove the level of ordinary skill in the art which pertains to the Wolf claims. This deficiency, it is said, makes it impossible to state one way or the other what one of ordinary skill in the art was capable of doing, or why in light of such skill such a person might have found the claimed invention lacking in nonobviousness.

Level of Skill in the Art

Some of the factors which have been considered in evaluating the level of ordinary skill in the art appear in the following excerpt from Jacobson Bros., Inc. v. United States, 512 F.2d 1065, 185 USPQ 168 (Ct. Cl. 1975):

[T]he various prior art approaches employed, the types of problems encountered in the art, the rapidity with which innovations are made, the sophistication of the

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technology involved, and the educational background of those actively working in the field are among the factors which will oftentimes aid in developing a picture of what is the level of skill of the ordinary person in an art. Considerations such as commercial success and the failure of others, characterized as "secondary" in Graham, are nonetheless invaluable as real-life indicia * * * of the level of skill in the art. * * *.

The appellee's proof of the issue of the level of skill in the art consists of the following: (1) The evidence adduced in support of its § 102 defenses (defenses the trial judge prohibited on procedural grounds); (2) the prior art patents; and (3) the testimony and educational qualifications of the witnesses who were working in the art of information processing systems hardware prior to May 26, 1958.

Page 199

[8] The evidence adduced in support of the § 102 defenses (the SAGE defense and the Air Force defense)⁷ can be probative on the issue of the level of skill in the pertinent art even if it be considered inadequate to establish the existence of a § 102 defense (an issue we do not reach). There is no distinction in this regard between § 102(a) proofs, Simmonds Precision Prods., Inc. v. United States, 153 USPQ 465, 468 (Ct.Cl. Trial Div. 1967) (case settled by stipulation of judgment for plaintiff), and § 102(g) proofs, Int'l Glass Co. v. United States, 408 F.2d 395, 161 USPQ 116 (Ct.Cl. 1969). Moreover, Jacobson, *supra*, leaves no doubt about the probativeness of prior art or the educational backgrounds of those working in the field.

In terms of the level of skill in the art at the time of the Wolf filing date, we accept the trial judge's finding that the evidence demonstrated the following facts: Those skilled in the art were able to coordinate specific input information with related stored data and then route this combined information based upon the original input information. It was within the level of skill in the art to conduct a system capable of performing calculations on the input information before associating it with the related stored data. It was also possible to have the calculations performed on the combined input information and stored data, and then route the calculation results in accordance with the initial input information. The level of skill had reached a point where all of the basic information transfer and manipulation techniques, e.g., accessing stored data from memory devices based on input information, and routing information based upon input information, were completely machine controllable. No human intervention was required in the systems which those skilled in the art of information processing hardware were capable of building at the time of the invention in suit. The advances being made in the level of skill in the art were primarily confined to improving the speed, reliability, and storage and handling capacities of the hardware. Electronic devices were replacing the electromechanical devices. The individuals working in the art were of above average intelligence and educational training. Many possessed advanced university degrees.

The Claims in Suit Lack Nonobviousness

[9][10] The question of nonobviousness is a simple one to ask, but difficult to answer. The person of ordinary skill in the art at the time of the patentee's invention, which in this

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case is May 26, 1958, is presumed to have before him all of the relevant prior art. As has been previously explained, the available art shows each of the elements of the claims in suit. Armed with this information, would it then be nonobvious to this person of ordinary skill in the art to coordinate these elements in the same manner as the claims in suit? The difficulty which attaches to all honest attempts to answer this question can be attributed to the strong temptation to rely on hindsight while undertaking this evaluation. It is wrong to use the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit. Monday morning quarterbacking is quite improper when resolving the question of nonobviousness in a court of law.

Mr. Bloch, the expert witness engaged by the appellee, testified that the claimed invention would be obvious to one of ordinary skill in the art at the time of Mr. Wolf's invention date. The testimony of this witness on this point consisted of conclusions without supporting explanations. The trial judge considered that the lack of supporting explanations was an omission which detracted from the persuasiveness of the conclusions of Mr. Bloch. Nonetheless the court below held that the testimony of this witness, when combined with other evidence, was sufficient to constitute a *prima facie* demonstration of obviousness pursuant to 35 U.S.C. § 103.

In rebuttal of this *prima facie* demonstration of obviousness, the appellants offered the testimony of Mr. Nikolai, a witness experienced on matters of patentability, though not a person of ordinary skill in the art of information processing systems hardware during the relevant time period. Mr. Nikolai testified that it would not be obvious to one of ordinary skill in the art to combine the Nelson-Robinson apparatus with the Andrews-Vibbard apparatus, both cited by the appellee, to achieve the result of the claims in suit. Building upon this point, appellants allude to the unlikelihood of a retail business using an apparatus like Andrews-Vibbard because of its enormous size, cost, and complexity in comparison to the needs of the retail businessman. However, Mr. Nikolai did not testify that it would not have been obvious to combine the elements found in the disclosures of Nelson-Robinson and Andrews-Vibbard and thereby arrive at the combination of elements recited in the claims in suit. There is a distinction between trying to physically com

Page 200

bine the two separate apparatus disclosed in two prior art references on the one hand, and on the other hand trying to learn enough from the disclosures of the two references to render obvious the claims in suit. Mr. Nikolai's testimony touched upon the former, but ignored the latter.

[11] Claims may be obvious in view of a combination of references, even if the features of one reference cannot be substituted physically into the structure of the other reference. *In re Anderson*, 391 F.2d 953, 958, 157 USPQ 277, 281 (CCPA 1968). What matters in the § 103 nonobviousness determination is whether a person of ordinary skill in the art, having all of the teachings of the references before him, is able to produce the structure defined by the claim. *In re Twomey*, 218 F.2d 593, 104 USPQ 273, 275 (CCPA 1955). The fact that features of one reference cannot be substituted into the structure of a

second reference may indicate that the claims were nonobviousness in view of the combined teachings of the two references. But this is not necessarily so, as Anderson, *supra*, makes clear. The same can be said regarding a complete mechanical misfit between two separate patented devices when the combination is alleged to demonstrate the obviousness of patent claims. But Mr. Nickolai's testimony does not address these points. Rather, he raises only the point that it was not likely that the Andrews-Vibbard apparatus would be integrated into the Nelson-Robinson apparatus by one of ordinary skill in the art. This may be so for reasons of economic feasibility, but not for any want of technological feasibility. The combination of these two inventions does not make good economic sense, but there is no mismatch between these technologies.

[12] In other words, the fact that the two disclosed apparatus would not be combined by businessmen for economic reasons is not the same as saying that it could not be done because skilled persons in the art felt that there was some technological incompatibility that prevented this combination. Only the latter fact is telling one the issue of nonobviousness.

[13] The failure of appellants to show the existence of a long-felt need for the patented device amply explains why no businessman would undertake to literally combine the Nelson-Robinson and Andrews-Vibbard apparatus. However, this does not indicate any technological incompatibility between these two prior art defenses. Indeed, as the trial judge correctly found, it appears quite feasible both economically and technologically, to combine the *several elements* comprising the Nelson-Robinson and Andrews-Vibbard devices to arrive at the claims in suit. Moreover, it appears that to do so would have been obvious to one of ordinary skill in the art at the time Wolf made his invention.

In sum, Judge Colaianni's conclusion of obviousness, which we accept, rests on the testimony of Mr. Bloch regarding the disclosures of the Nelson-Robinson and Andrews-Vibbard patents, and the exhibits and testimony offered by the appellee in support of its prohibited § 102 defenses. Moreover, the inability of the appellants to effectively undermine the foregoing evidence or to present evidence of such factors as long-felt need, teaching away in the prior art, the failure of others, and commercial success, leaves the appellee's *prima facie* case of obviousness unshaken.

II — Deposition Costs

This part of the opinion considers the deposition costs of appellants' expert witness. Judge Colaianni found in his opinion below that the cross-appellant had earlier offered to pay the reasonable and necessary expenses associated with such a deposition, and that the judge had previously determined (in his order of August 10, 1979) the amount of money which defendant had previously obligated itself to pay; in the judge's view, he had determined the dollar amount of the costs which the defendant voluntarily had offered to pay in order to secure permission to depose Mr. Nikolai. Since the cross-appellant continued to dispute \$1,181.25 of the amount of the judge's dollar determination, an amount which to this day remains unpaid, the judge thereafter concluded as a matter of law that the defendant's offered payment was overdue. This order was reviewed by the Court of Claims in its order dated June 26, 1981. In this order the court stated:

In preparing his ultimate report, the trial judge should then treat the costs issue (when there is one) in the same manner as all substantive legal issues in the cases,

i.e., he should make proposed findings of fact and conclusions of law on the court issue.

In his opinion below, Judge Colaianni said: "Neither the parties nor I ever anticipated that this dispute as to the amount of the costs presented a triable issue. It began purely as a matter incidental to discovery. Both parties were silent on this matter in their post-trial briefs and proposed findings of fact. There is no evidence in the trial record upon which to base factual findings, nor, in view of the court's June 26, 1981, order, are there any legal issues left to be resolved. My original determinations were based upon the statements of counsel and my own personal

Page 201

knowledge of the events. All of this information appears in my orders and the related motions of the parties. These orders are dated: January 24, 1979; March 23, 1979; August 10, 1979; April 24, 1981; May 11, 1981; Thus, I reaffirm the conclusion of my August 10, 1979, order as to the \$1,181.25 amount which the defendant promised to pay to the plaintiffs as part of the reasonable and necessary costs of the deposition in question."

We are satisfied that Judge Colaianni's decision on this issue (together with his finding on the point) met the essential requirement of the Court of Claims order, *supra*, and, having thoroughly reviewed his orders and memoranda as well as the numerous related motions and responses by both parties, we accept his determination both as to the amount due and the circumstances giving rise to the determination of that particular amount. Our review of the record reveals a history of poor relations between these parties over matters pertaining to discovery, apparently having begun with appellants' refusal to answer certain interrogatories by the Government. This refusal was confirmed by order of Judge Colaianni on December 22, 1978, in which he stated that "[t]o require plaintiffs to answer these interrogatories would, in effect, be ordering plaintiffs to prepare defendant's case for it. That is hardly within the purpose or scope of the discovery rules."

The Government did not appeal that refusal, but then sought, and was granted, the right to depose appellants' expert witness Mr. Nikolai, claiming that this deposition was its only remaining avenue for gaining information it needed. Those deposition costs are here at issue as a result of the trial judge's decision both that the Government had earlier agreed to pay reasonable and necessary expenses associated with this deposition and also that a portion of the deposition was used by the Government to "develop" its case. Those determinations are supported by the record and have not been shown by the cross-appellant to have been either erroneous in law or abuses of discretion. Cf. Fed.R. Civ. P. 26(C).

III — Conclusion

Appellants are entitled to collect \$1,181.25 as part of the reasonable and necessary costs of the deposition of Mr. Nikolai. The claims in suit are invalid for obviousness per 35 U.S.C. § 103 (1976), and accordingly the petition was properly dismissed subject to the Government's payment of \$1,181.25 to appellants.

Affirmed.

Footnotes

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Footnote * Pursuant to the order of this court dated October 4, 1982, the Claims Court thereafter issued a final judgment in accordance with Trial Judge Colaianni's recommended decision of August 14, 1981. We treat both sides' exceptions to that decision as an appeal and cross-appeal from that judgment. Appellants, plaintiffs in the Court of Claims, filed their exceptions first and we designate them appellants and cross-appellees.

Footnote 1. The rearranged sequencing and the subparagraphing is superimposed on the claims of the patent solely for the purpose of facilitating discussions involving the claims. The superimposition permits a precise identification of the various claim elements. It is a more detailed location scheme than the column and line-number scheme which one finds in patents. The rearranged sequencing has no bearing on the patentability of these particular claims. The following shorthand will be used in this opinion: Claim 2(a)(1), or element 2(a)(1), shall refer to subparagraph (a)(1) of claim 2 of the Wolf patent, i.e., "An electrical system."

Footnote 2. United States Letters Patent No. 2,977,048.

Footnote 3. United States Letters Patent No. 2,987,704.

Footnote 4. Trial transcript, pp. 87-88.

Footnote 5. Mr. Nikolai testified: "My experience at Univac in the early days involved exposure to digital computer hardware, digital communication hardware."

Footnote 6. The appellants conceded this fact below.

Footnote 7. SAGE is an acronym for the Semi-Automatic Ground Environment air defense system. The other air force system mentioned is the Air Force's early AUTODIN system defense. These are both adverted to in more detail in the findings below.

Concurring Opinion Text

Concur By:

Niles, Circuit Judge, concurring.

I agree with the majority that the judgment of the Claims Court that the asserted claims of the Wolfe patent are invalid under 35 USC § 103 should be affirmed. In my view, the majority adopts portions of the trial judge's opinion which are unnecessary to the issues on appeal and, thus, to a great extent the majority's opinion is dictum.

Appellants make no attack on use of Andrews-Vibbard as a prior art reference apart from the fact that it is a large, expensive, and specialized machine which a businessman would not have considered a practical tool to use in connection with selection of the items of merchandise ordered by a customer or for preparing a pricing invoice. I agree with the majority that this argument does not destroy the relevancy of Andrews-Vibbard.

The trial judge found that the apparatus disclosed in Nelson-Robinson and Andrews-Vibbard can be physically combined. Appellants do not show any error in this conclusion. In view of the teachings of these prior art references and the problem confronting the inventor, the trial judge did not err in holding that the subject invention would have been obvious to one of ordinary skill in the art on the record before him.

- End of Case -

EXHIBIT H

FULL TEXT OF CASES (USPQ2D)

All Other Cases

**Ex parte Humphreys (BdPatApp&Int) 24 USPQ2d 1255 Ex parte
Humphreys**

**U.S. Patent and Trademark Office, Board of Patent Appeals and
Interferences
24 USPQ2d 1255**

**Decided February 28, 1992 On Reconsideration June 29, 1992 Released August 7, 1992
No. 91-2889**

Headnotes**PATENTS****1. Patentability/Validity -- Specification -- Enablement (§ 115.1105)**

Written description of application encompassing claims for isolation of genes for biosynthesis of polyketide antibiotics does not enable one skilled in art to practice inventions absent access to plasmid believed to include entire set of actinorhodin biosynthesis genes (pIJ2303), and only manner in which applicants can satisfy their burden of assuring public access to this needed biological material is by themselves undertaking responsibility of making appropriate deposit of material, and thus such deposit is necessary in order to comply with enablement requirement of 35 USC 112, first paragraph; purported milbemycin gene cluster (fragment MC) need not be deposited, however, in view of lack of any showing that one having access to pIJ2303 would not be enabled to obtain fragment MC using well known techniques.

2. Patentability/Validity -- Specification -- Enablement (Section 115.1105)

Examiner, in rejecting claims involving isolation and identification of complete gene cluster responsible for biosynthesis of polyketide antibiotic and expression of this gene cluster in *Streptomyces* strain which does not

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normally produce this antibiotic, correctly, in view of unpredictability of such physiological activity, shifted burden of proof to applicants to establish through objective evidence that methods encompassed by claims are enabled throughout their scope.

Page 1256

Case History and Disposition:

Appeal from final rejection of claims (Richard A. Schwartz, primary examiner, R. Peet, examiner).

Application for patent, serial no. 06/943,671, filed Dec. 17, 1986, by Gwynfor O. Humphreys, Christopher R. Bailey, and Christine A. McKillop (isolation of genes for biosynthesis of polyketide antibiotics). From decision rejecting claims, applicants appeal. Affirmed.

Judge:

Before Winters, W. Smith, and Garris, examiners-in-chief.

Opinion Text

Opinion By:

Smith, examiner-in-chief.

This is an appeal from the final rejection of claims 1 and 3 through 42, all the claims in the application. A copy of the claims is attached to this decision.

The references relied upon by the examiner are:

Malpartida et al. (Malpartida 1984), "Molecular Cloning Of The Whole Biosynthetic Pathway Of A *Streptomyces* Antibiotic And Its Expression In A Heterologous Host", *Nature*, Vol. 309, pages 462-464 (1984). Rose, "Secondary Products Of Metabolism", *Economic Microbiology*, Vol. 3, pages 355-387 (1979).¹

Among the references relied upon by appellants are:

Malpartida et al. (Malpartida), "Molecular Cloning Of The Whole Biosynthetic Pathway Of A *Streptomyces* Antibiotic And Its Expression In A Heterologous Host", *Nature*, Vol. 309, pages 462-464 (1984). Hopwood, et al. (Hopwood), *Genetic Manipulation Of Streptomyces*, A Laboratory Manual, John Innes Foundation, (1985) (Hopwood I). Pouwels et al. (Pouwels), *Cloning Vectors*, A Laboratory Manual, Elsevier, (1985). Lydiate et al. (Lydiate), "The *Streptomyces* Plasmid SCP2*: Its Functional Analysis And Development Into Useful Cloning Vectors", *Gene*, Vol. 35, pages 223-235 (1985). Hopwood, "Cloning And Analysis of Antibiotic Biosynthetic Genes In *Streptomyces*", *Sixth Int. Symp. On Actinomycetes Biology*, pages 3-14 (1985) (Hopwood II).

Malpartida et al. (Malpartida), "Physical and Genetic Characterization Of The Gene Cluster For The Antibiotic Actinorhodin in *Streptomyces Coelicolor* A3(2)", *Mol. Gen. Genet.*, Vol. 205, pages 66-73 (1986). Stanzak et al. (Stanzak), "Cloning And Expression In *Streptomyces Lividans* Of Clustered Erythromycin Biosynthesis Genes

From *Streptomyces Erythreus*", *Bio/Technology*, Vol. 4, pages 229-232 (March 1986). Motamedia et al. (Motamedia), "Cloning And Heterologous Expression Of A Gene Cluster For The Biosynthesis Of Tetracenomycin C, The Anthracycline Antitumor Antibiotic Of *Streptomyces Glaucescens*", *Proc. Natl. Acad. Sci. USA*, Vol. 84, pages 4445-4449 (1987).

Page 1257

Malpartida et al. (Malpartida), "Homology Between *Streptomyces* Genes Coding For Synthesis Of Different Polyketides Used To Clone Antibiotic Biosynthetic Genes", *Nature*, Vol. 325, pages 818-921 (1987). Ikeda et al. (Ikeda), "Genetic Studies Of avermectin Biosynthesis In *Streptomyces avermitilis*, *Journal Of Bacteriology*, Vol. 169, No. 12, pages 5615-5621 (1987). Hallam et al. (Hallam), "Nucleotide Sequence, Transcription And Deduced Function Of A Gene Involved In Polyketide Antibiotic Synthesis In *Streptomyces Coelicolor*", *Gene*, Vol. 74, pages 305-320 (1988). Horinouchi et al. (Horinouchi), " afsB Stimulates Transcription Of The Actinorhodin Biosynthetic Pathway In *Streptomyces Coelicolor* A3(2) And *Streptomyces Lividans*", *Mol. Gen. Genet.*, Vol. 215, pages 355-357 (1989). Sherman et al. (Sherman), "Structure And Deduced Function Of The Granaticin-Producing Polyketide Synthase Gene Cluster Of *Streptomyces Violaceoruber* Tu22", *The EMBO Journal*, Vol. 8, No. 9, pages 2712-2725 (1989). Gewain et al. (Gewain), "Cloning *Streptomyces avermitilis* Genes For avermectin Biosynthesis", H-113, date not given.

The claims stand rejected as follows:

- I. Claims 3 through 8, 11 through 16, and 18 through 42 under 35 USC Section 112, first paragraph;
- II. Claims 1 and 3 through 26 under 35 USC Section 112, first paragraph;
- III. Claims 1, 3 through 5, 9 through 13, and 17 under 35 USC Section 102(b) as anticipated by Malpartida 1984;
- IV. Claims 6 through 8, 14 through 16, 18 through 23, and 29 through 42 under 35 USC Section 103 as unpatentable over Malpartida 1984 in view of Rose.

BACKGROUND

The many aspects of the present invention appear to be based in large part upon the work discussed in Malpartida 1984 concerning the isolation of the entire DNA sequence corresponding to the structural genes for actinorhodin biosynthesis. Actinorhodin is an antibiotic produced by *Streptomyces coelicolor* (*S. coelicolor*). Working with a series of six actinorhodin non-producing mutants, the authors were able to isolate and identify a transformed *S. coelicolor* strain containing a plasmid (pIJ2303) believed to include the entire set of actinorhodin biosynthesis genes. Subsequent work including the insertion of pIJ2303 into a separate *Streptomyces* strain which does not produce actinorhodin confirmed that pIJ2303 contains the entire DNA sequence corresponding to the structural genes for actinorhodin biosynthesis.

Malpartida 1984 also discloses that certain *Streptomyces* strains produce nearly two-thirds of the known natural antibiotics and that the genes for antibiotic synthesis in such species tend to be clustered together on the chromosomes of the microorganism. The reference also acknowledges that it is generally accepted that antibiotics such as actinorhodin which are biosynthesized through the polyketide pathway are assembled on multi-enzyme complexes and that the gene clusters that encode polyketide synthetases may have had a common evolutionary origin.

On the basis of all of this information, the authors concluded that the DNA sequence corresponding to the structural genes for actinorhodin biosynthesis (pIJ2303) may possibly be used as DNA probes for the isolation of other antibiotic synthetases which are produced via the polyketide pathway.

Malpartida 1986 2 identifies subclones of pIJ2303, e.g., pIJ2305 and pIJ2308, as well as regions of these subclones which contain specific genes associated with the six classes of the actinorhodin non-producing mutants used to isolate pIJ2303. For example, the structural gene(s) represented by a Class III mutant is disclosed to be

contained in pIJ2305.

The Malpartida references indicate that the authors were associated with the John Innes Institute. As set forth in Example I of this application, the present inventions are based upon pIJ2303, pIJ2305, and pIJ2308. Appellants acknowledge on page 8 of the Appeal Brief and page 3 of the Reply Brief that pIJ2303 was obtained from the John Innes Institute.

Employing conventional, well known techniques, appellants conducted hybridization studies of *Streptomyces* sp. B41-146 (a known producer of the polyketide antibiotic milbemycin) using the pIJ2305 insert as a probe to identify the genes responsible for milbemycin production. Subsequently, in order

Page 1258

to identify the region of insert pIJ2305 which hybridized to *Streptomyces* sp. B41-146, a 1.1 *Bam* HI fragment of pIJ2305 was formed and found to hybridize to an 8.0 KB fragment of *Streptomyces* sp. B41-146 DNA. The 1.1 *Bam* HI fragment of pIJ2305 was identified by Malpartida 1986 to contain the structural gene(s) associated with a Class III mutant.

After identifying several fragments of *Streptomyces* sp. B41-146 which hybridized to the probes obtained from pIJ2305, appellants constructed a composite DNA sequence which was named MC. Appellants postulate that this DNA fragment contains the genes necessary for biosynthesis of milbemycin. However, the entire MC sequence was not inserted in a non-producing milbemycin *Streptomyces* strain in order to determine whether this DNA fragment does in fact contain all of the structural genes needed for milbemycin production as Malpartida 1984 did with pIJ2303. Rather, appellants used fragments of the MC fragment in insertional inactivation studies of the milbemycin genes of *Streptomyces* sp. B41-146. As set forth in Example 6 of the present specification, these studies indicate that the specific fragments tested do contain genes essential for milbemycin production. However, it is not stated that *all* genes needed for milbemycin production are present on fragment MC.

Claims 1 and 3 through 8 on appeal are directed to a method of isolating *a* gene involved in the biosynthesis of a first polyketide antibiotic which involves the use of nucleic acid probes which comprise at least *a part* of *a* gene involved in the biosynthesis of a second polyketide antibiotic. For example, part of pIJ2303, e.g., pIJ2305, is used as a probe in order to identify a part of a gene involved in the biosynthesis of milbemycin.

Claims 9 through 23 are directed to methods for producing a first polyketide antibiotic in a naturally non-producing strain of a bacterium of the genus *Streptomyces* which involves obtaining the *complete* gene cluster of the first polyketide antibiotic. The specific steps involved in obtaining the complete gene cluster are acknowledged to be conventional and well known. The key to this method appears to be the availability of a nucleic acid sequence containing at least a part of a gene involved in the biosynthesis of a second polyketide antibiotic for use as a probe. It should be noted that these claims require the positive step of introducing the clone fragment thought to contain the complete cluster of biosynthetic genes responsible for production of the first polyketide antibiotic into a non-producing strain of *Streptomyces* and *producing* the first polyketide antibiotic in the normally non-producing *Streptomyces* strain.

Claims 29 through 42 are directed to DNA fragments, hybridization probes, vectors, and transformed bacterial strains used in the hybridization and antibiotic production methods.

Claims 24 through 28 are directed to a separate aspect of the present invention. As set forth in Malpartida 1984 and Malpartida 1986, the Class II gene involved in the biosynthesis of actinorhodin production in *S. coelicolor* is apparently involved in regulation of the polyketide pathway. As set forth in Example 4 of the present application, appellants have found that transforming a *Streptomyces* strain which contains the genes for production of actinorhodin but is not capable of normally producing the antibiotic with certain DNA fragments from *Streptomyces* sp. B41-146 results in the normally non-producing strain being capable of producing actinorhodin. Using the nomenclature of Malpartida, appellants identify the gene included in these DNA fragments which is responsible for "turning on" actinorhodin production in the normally non-producing *streptomyces* strain as

milbemycin gene II.

ISSUES

The issues presented in this appeal are the correctness of the examiner's rejections.

OPINION REJECTION I

The examiner has concluded that one skilled in the art is enabled to practice claims 3 through 8, 11 through 16, and 18 through 42 only if certain of the biological material used by appellants is deposited per the procedures set forth in MPEP Section 608.01(p)C. In reaching this conclusion, the examiner has expressed concern in regard to whether the written description of the present invention is sufficiently repeatable and whether certain of the starting materials are readily available to the public. In expressing these concerns on pages 3-6 of the Examiner's Answer, the examiner has not specifically stated which of the myriad biological materials involved in the present invention should be deposited. In arguing this rejection in the Appeal Brief, appellants have indicated that plasmid pIJ2303 and the purported milbemycin gene cluster (fragment MC) are the biological materials which the examiner has required to be deposited.

Page 1259

As set forth above, appellants acknowledge that the present invention does employ DNA probes obtained from pIJ2303 but assert that this plasmid is available to the public from the John Innes Institute. Appellants rely upon publications bearing publication dates both before and after the present filing date which refer to either pIJ2303 or other plasmids which contain various of the actinorhodin genes identified by Malpartida 1984 and 1986, arguing that these references indicate that pIJ2303, its actinorhodin gene insert, or functional equivalents thereof have been made available to a variety of universities and industrial laboratories.

Appellants have also traced the manner in which pIJ2303 was developed as documented in the prior art. See the paragraph bridging pages 3-4 of the Reply Brief, relying upon, *inter alia*, Hopwood I. As explained by appellants, the genesis of this plasmid can be traced to ultraviolet mutagenesis of certain bacterium. Appellants assert that mutagenesis is a well-known and reproducible technique so that pIJ2303 can be reconstructed by those skilled in this art if the plasmid is not publicly available. Appellants also refer to disclosures in other references, e.g., Malpartida 1984, that the mutant strains from which pIJ2303 was developed are maintained at the John Innes institute so that it may be implied that these mutant strains are available to researchers interested in reconstructing this plasmid.

Alternatively, appellants argue that the nucleotide sequence of the 1.1 *Bam* HI fragment containing the gene associated with Class III mutants was published subsequent to the filing date of this application (Hallam). We have carefully considered appellants' position but agree with the examiner that the written description of this application does not enable one skilled in the art to practice the inventions encompassed by the rejected claims absent access to pIJ2303 and that this plasmid must be deposited under appropriate conditions.

In regard to reconstructing pIJ2303, we point out that appellants have not provided any evidence on this record that ultraviolet mutagenesis of bacteria is a reproducible phenomenon so that the mutant bacteria needed in order to reconstruct pIJ2303 may be obtained without undue experimentation. Attorney's argument in a brief does not take the place of factual evidence. *In re Greenfield*, 571 F.2d 1185, 197 USPQ 227 (CCPA 1978).

As to appellants' arguments concerning the apparent availability to the public of pIJ2303 and/or its parent mutant strains from the John Innes Institute, we point out that appellants receipt of pIJ2303 from the John Innes Institute as well as the ability of others to obtain this or similar material from this establishment prior to and after the present filing date does not establish that upon issuance of a patent on this application that such material would continue to be accessible to the public from the John Innes Institute. Appellants have not made of record any of

the facts and circumstances surrounding their obtention of material from the John Innes Institute nor is there any evidence as to what its policy is in this regard, either now or in the future if a patent were to issue on this application. On this record, there is no assurance that the John Innes Institute would allow unlimited access to pIJ2303 if this application were to mature into a patent.

In response to appellants' reliance upon the later published Hallam reference for its disclosure of the nucleotide sequence of one of the genes involved in the present invention, the examiner argues that such a later published reference is not available for appellants' use to establish enablement, citing *In re Glass*, 492 F.2d 1228, 181 USPQ 31 (CCPA 1974). Appellants respond that under the circumstances of this application, the later published reference may be relied upon in this manner, citing *In re Lundak*, 723 F.2d 1216, 227 USPQ 90 (Fed. Cir. 1985). We do not find it necessary to resolve this specific issue since, assuming arguendo, Hallam is properly relied upon by appellants, we do not find that it relieves appellants of their burden of depositing pIJ2303.

At best, Hallam discloses the nucleotide sequence of a single gene involved in the present invention. Appellants have not explained on this record how this disclosure in and of itself enables practice of the present invention throughout the breadth of the rejected claims. Appellants direct attention to dependent claims 4 and 12 which are stated to be limited to the use of the subsequently published nucleotide sequence. We disagree. These claims only require the use of "the nucleic acid sequence of at least a part of the actinorhodin gene III" and are not limited to the use of the subsequently published nucleotide sequence as argued.

[1] From this record, it appears that the only manner in which appellants can satisfy their burden of assuring public access to this needed biological material upon issuance of

Page 1260

a patent is by themselves undertaking the responsibility of making an appropriate deposit of this material. Therefore, we conclude that appellants must deposit pIJ2303 in order to comply with the enablement requirement of 35 USC Section 112, first paragraph.

As to the examiner's concern that fragment MC must also be deposited, we note that this fragment was obtained by using what are acknowledged to be well known techniques using pIJ2303. The examiner has not explained why one having access to pIJ2303 upon issuance of a patent on this application would not be enabled to obtain fragment MC using these well known techniques. Absent a cogent explanation from the examiner, we do not find that appellants need deposit fragment MC.

REJECTION II

We reverse this rejection as it applies to claims 1 and 3 through 8 and affirm this rejection as it applies to claims 9 through 26.

From the statement of the rejection it appears that the examiner's concern in separately rejecting these claims under this section of the statute is in regard to their breadth. In other words, assuming public access to pIJ2303 upon issuance of a patent based upon this application, those skilled in the art would not be enabled to practice these claims throughout their scope without undue experimentation. See *In re Wands*, 858 F.2d 731, 8 USPQ2d 1400 (Fed. Cir. 1988).

Claims 1 and 3 through 8 are directed to a conventional method of hybridization in order to isolate a gene involved in the biosynthesis of a first polyketide antibiotic. Appellants and the examiner agree that the manipulative steps involved in these claims are well known in this art. It is not clear from the examiner's statement of the rejection specifically what concerns he has in regard to claims 1 and 3 through 8. Having isolated the complete gene cluster for actinorhodin biosynthesis in pIJ2303, Malpartida 1984 states that this plasmid may be possibly useful as DNA probes for the isolation of other antibiotic synthetases. Hopwood II also suggests the use of cloned DNA such as that of pIJ2303 as a probe to isolate the genes encoding for other polyketide synthetases. See Strategy 7 in Table 1 of Hopwood II.

In view of this disclosure of Malpartida 1984 and Hopwood II to use the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of a second polyketide antibiotic as a probe to screen a clone library of genomic DNA from a microorganism which produces a first polyketide antibiotic, it is difficult to determine precisely which step(s) of claims 1 and 3 through 8 is not enabled or would require undue experimentation.

Claims 9 through 23 are directed to methods for producing a polyketide antibiotic in a naturally non-producing strain of a bacterium of the genus *Streptomyces*. As seen from claim 9(a)(vii), an essential step of the claimed method is to identify and isolate a DNA fragment which comprises the complete gene cluster for producing the desired polyketide antibiotic by actual production of this polyketide antibiotic in a nonproducing strain of *Streptomyces*. Claim 22, while limited to the use of DNA fragment MC in a naturally non-milbemycin producing strain of a bacterium of the genus *Streptomyces*, contains a similar requirement.

As set forth in *In re Fisher*, 427 F.2d 833, 839, 166 USPQ 18, 24 (CCPA 1970): [Section 112] requires that the scope of the claims must bear a reasonable correlation to scope of enablement provided by the specification to persons of ordinary skill in the art.

* * * In cases involving unpredictable factors, such as most chemical reactions and physiological activity, the scope of enablement varies inversely with degree of unpredictability of the factors involved. [2] Here, the rejected claims involve the isolation and identification of the complete gene cluster responsible for biosynthesis of a polyketide antibiotic and the expression of this gene cluster in a *Streptomyces* strain which does not normally produce this antibiotic. Due to the unpredictability of such physiological activity, we conclude that the examiner has correctly shifted the burden of proof to appellants to establish through objective evidence that the methods encompassed by claims 9 through 23 are enabled throughout their scope.

Appellants rely upon the working examples of the present specification as rebuttal evidence. We have carefully considered this evidence but do not find it is probative of enablement. First, the work set forth in the working examples is directed only to the obtention of the gene cluster for the biosynthesis of milbemycin using the actinorhodin gene cluster as the probe. However, we agree with the examiner that even this single limited showing does not establish that fragment MC represents a gene cluster responsible for milbemycin production as asserted. Example 6 of the specification only used fragments of fragment MC in homologous recombination experiments. The conclusions reached in Example

Page 1261

amount to only statements that the tested fragments of fragment MC "contain genes essential for milbemycin production." It is only inferred from this work that fragment MC contains all of the genes required for milbemycin production in a non-producing *Streptomyces* strain as required by these claims on appeal. From this record, it appears that those skilled in this art would conclude that a clone fragment contains the *complete* cluster of genes needed for biosynthesis of a polyketide antibiotic in a normally non-producing *Streptomyces* strain only when its introduction into a non-producing strain results in the production of the desired polyketide antibiotic as in Malpartida 1984.

Appellants rely upon Motamedi and Stanzak as successful examples of introducing gene clusters for the biosynthesis of a first polyketide antibiotic into a non-producing *Streptomyces* strain for the polyketide antibiotic and obtaining expression of the desired antibiotic. However, appellants have not established on this record that the gene clusters of these references were obtained using the probing procedures required by the rejected claims. 4 It is of interest to note however that the conclusions reached by the authors of these two references concerning production of a polyketide antibiotic in a normally non-producing *Streptomyces* strain are based upon incorporation of the purported gene cluster in such a strain and the subsequent observation of antibiotic production in the transformer strain. This is further evidence that those skilled in this art would not readily accept the procedure set forth in Example 6 of the present specification as evidence that the fragment MC does in fact contain the complete set of genes needed for a biosynthesis of milbemycin in a non-producing

Streptomyces strain.

We also affirm this rejection as it pertains to claims 24 through 26. There is no evidence of record which establishes that milbemycin Gene II is a universal activator in regard to either the desired polyketide antibiotic or the normally inactive *Streptomyces* strain as encompassed by these claims.

The examiner has not included any of claims 29 through 42 in this rejection. While it may be that access to pIJ2303 will enable one skilled in the art to obtain the numbered fragments set forth in claims such as claim 42 per the teachings of the present disclosure, it is not clear why one would be enabled to practice generic claims such as claims 29, 30, 37, and 41 throughout their scope. It is also not clear why claim 28 is not included in this rejection since the production of *an avermectin* in the manner required by this claim has not been shown to be an enabled species of claim 24. We decline to exercise our discretion under 37 CFR Section 1.196(b) and enter new grounds of rejection. However, these issues should be considered by appellants and the examiner if prosecution of this subject matter is continued in a continuing application.

REJECTION III

We affirm this rejection as it applies to claims 1 and 3 through 5 and reverse the rejection as it applies to claims 9 through 13 and 17.

In discussing the enablement issue as raised in regard to hybridization claims 1 and 3 through 5, we found that the suggestion of Malpartida 1984 to use the gene cluster found in pIJ2303 as probes to isolate other polyketide antibiotic synthetases was capable of being implemented by those skilled in the art since the needed procedures were well known and conventional. On this basis, we agree with the examiner's conclusion that Malpartida 1984 is an anticipation of the procedure set forth in claims 1 and 3 through 5. By "suggesting" that pIJ2303 be used as a DNA probe for isolation of other polyketide antibiotic synthetases, Malpartida 1984 is describing the conventional steps known at that time for implementing such a procedure. Claims 1 and 3 through 5 call for nothing more.

Appellants argue that there is no enabling teaching in Malpartida 1984 for their invention. However, appellants have not explained on this record what aspect of claims 1 and 3 through 5 is not disclosed in Malpartida 1984. As set forth in *In re Donohue*, 632 F.2d 123, 207 USPQ 196 (CCPA 1980):

For a publication to constitute an anticipation of an invention and, thus, to bar the grant of a patent under 35 USC 102, it must be capable, when taken in conjunction with the knowledge of those skilled in the art to which it pertains, of placing that invention in the possession of the public. *In re LeGrice*, 49 CCPA 1123, 1145, 301 F.2d 929, 944, 133 USPQ 365, 378 (1962), *In re Brown*, 51 CCPA 1254, 1259, 329 F.2d 1006, 1011, 141 USPQ 245, 249 (1964).

Page 1262

Appellants argue that a prior art reference must not require independent experimentation in order to practice the invention to be considered an anticipation. Assuming this to be the case, appellants has not set forth what experimentation is needed. The fact that Malpartida 1984 may not have actually reduced to practice the suggested probing procedure has no bearing on whether that procedure is described in the reference. See *In re Sivaramakrishnan*, 673 F.2d 1383, 213 USPQ 441 (CCPA 1982) and cases cited therein.

We reverse this rejection as it applies to claims 9 through 13 and 17 since Malpartida 1984 only discloses the use of pIJ2303 as a probe for isolating other polyketide antibiotic synthetases and does not describe the more comprehensive method of producing polyketide antibiotics required by these claims.

REJECTION IV

We reverse this rejection. As set forth above in regard to the anticipation rejection, *Malpartida* 1984 only discloses that pIJ2303 can be used to locate other polyketide antibiotic synthetases using well known hybridization techniques. Whether such hybridization studies would necessarily lead to the obtention of all of the genes required for the biosynthesis of another polyketide antibiotic in a *Streptomyces* strain which would normally not produce it is a matter of much conjecture. As set forth above in regard to the enablement rejection for these claims, we have concluded that those skilled in the art would not be enabled as of the filing date of this application to practice the methods called for by these claims throughout their scope. The examiner's rejection is not specific as to how one of ordinary skill in the art would have found it obvious to practice any specific method within the scope of these claims as of the filing date of this application. In this regard, we note that the examiner has not explained with any specificity on this record how Rose, either as discussed on page 2 of the present specification or from a consideration of the entire reference as supplied by appellants, would have suggested in combination with *Malpartida* 1984 the methods set forth by these claims.

The decision of the examiner is affirmed.⁵

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR 1.136(a). See the final rule notice, 54 F.R. 29548 (July 13, 1989), 1105 O.G. 5 (August 1, 1989).

AFFIRMED

ON REQUEST FOR RECONSIDERATION June 29, 1992

Appellants request reconsideration of our decision of February 28, 1992.

Appellants first assert that we erred in agreeing with the examiner that pIJ2303 must be deposited under appropriate conditions in order for claims 3 through 8, 11 through 16, and 18 through 14 to be enabled. Appellants renew their arguments that one skilled in this art would be able to practice the claimed invention by using art-known techniques and readily available materials. We have carefully considered appellants' renewed arguments in this regard, but do not find our decision to be in error. While the mutation techniques in issue may be routine and well known in the art, appellants have not established on this record that such mutation techniques may be used to reproduce the needed materials without undue experimentation. The references of record relied upon by appellants as examples of successful use of mutation techniques do not address this issue in that there is insufficient background information from which one can conclude whether the successful results reported were routine rather than exceptional.

As to appellants' request for clarification of this rejection in regard to claims 4 and 12 in the paragraph bridging pages 5-6 of the Request for Reconsideration, we point out that the sole argument in the Appeal Brief of these claims is found on page 10 thereof where appellants' stated that these claims "rely only on the use of *act* III gene sequences." As pointed out on page 13 of our opinion, claims 4 and 12 only require the use of "the nucleic acid sequence of at least a part of the actinorhodin gene III." They are not limited to the use of the subsequently published sequence. The new arguments presented in regard to this issue in the Request for Reconsideration are untimely and we decline to consider them.¹

Page 1263

As to appellants' arguments concerning whether the examiner correctly shifted the burden of proof to appellants to establish through objective evidence that the methods encompassed by claims 9 through 23 are enabled throughout their scope, we refer again to our discussion of this issue on pages 16-19 of our opinion. Appellants argue that a mere statement that the art is unpredictable is not a sufficient basis for the examiner to shift the burden of proof citing *In re Marzocchi*, 58 CCPA 1069, 439 F.2d 220, 169 USPQ 367 (1971). However, as set forth in *Marzocchi*, the unpredictability of a particular art area may *alone* be enough to create a reasonable doubt in this regard. For the reasons set forth in our original decision, we decline to change our decision in this

matter.

We have also carefully considered the arguments set forth on pages 8-10 of the Request in regard to the prior art rejection of claims 1 and 3 through 5 for lack of novelty. Appellants' renewed arguments are answered in our original decision.

We have carefully reconsidered our decision in light of appellants' Request for Reconsideration, but decline to change our decision in any manner.

DENIED

APPENDIX

1. A method for isolating a gene involved in the biosynthesis of a first polyketide antibiotic which comprises the steps of:

a. preparing a clone library wherein each clone contains a fragment of DNA from a microorganism which is a bacterium of the genus *Streptomyces* which produces said first polyketide antibiotic;

b. screening said clone library for hybridization to a nucleic acid probe molecule which comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of a second polyketide antibiotic in a bacterium of the genus *Streptomyces*; and

c. selecting those clones which hybridize to said nucleic acid probe molecule thereby isolating a clone which contains a fragment of DNA which comprises said gene involved in the biosynthesis of said first polyketide antibiotic.

3. A method according to claim 1 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of actinorhodin.

4. A method according to claim 3 wherein said nucleic acid probe comprises the nucleic acid sequence of at least part of the actinorhodin Gene III.

5. A method according to claim 3 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of the actinorhodin Gene I.

6. A method according to claim 1 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of milbemycin.

7. A method according to claim 6 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of the milbemycin Gene III.

8. A method according to claim 6 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of the milbemycin Gene I.

9. A method for producing a first polyketide antibiotic in a naturally non-producing strain of a bacterium of the genus *Streptomyces* which comprises the steps of:

a. isolating a DNA fragment which comprises the clustered biosynthetic genes for said first polyketide antibiotic from a strain of a bacterium of the genus *Streptomyces* which produces said first polyketide antibiotic wherein said isolation comprises the steps of:

i. preparing a clone library wherein each clone contains a fragment of DNA from a microorganism which produces said first polyketide antibiotic;

ii. screening said clone library for hybridization to a nucleic acid probe molecule which comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of a second polyketide antibiotic;

iii. selecting those clones which hybridize to said nucleic acid probe molecule thereby isolating a clone which comprises a first DNA fragment which comprises at least part of the biosynthetic gene cluster of said first polyketide antibiotic;

iv. testing said first selected DNA fragment which comprises at least part of the biosynthetic gene cluster of said first polyketide antibiotic for the ability to direct synthesis of said first polyketide antibiotic in said non-producing

strain of *Streptomyces*;

v. rescreening said clone library or a second clone library with a nucleic acid probe which comprises the right or left terminal region of said first selected DNA fragment;

Page 1264

vi. selecting those clones which hybridized to the right or left terminal region of said first selected DNA fragment thereby isolating a clone which comprises a second DNA fragment which comprises chromosomal DNA sequences to the right or left of said first selected clone;

vii. repeating said testing, rescreening and selection steps employing said second selected DNA fragment and subsequent selected DNA fragments until said DNA fragment which comprises the clustered biosynthetic genes for said first polyketide antibiotic is isolated as ascertained by production of said first polyketide antibiotic in said nonproducing strain of *Streptomyces* in said testing step; and

b. introducing said cloned fragment containing said cluster of biosynthetic genes into said non-producing strain of a bacterium of the *Streptomyces*, thereby producing said polyketide antibiotic in said non-producing strain of *Streptomyces*.

10. A method according to claim 9 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of a gene involved in an early step of the biosynthesis of said second polyketide antibiotic.

11. A method according to claim 9 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of actinorhodin.

12. A method according to claim 11 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of actinorhodin Gene III.

13. A method according to claim 11 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of actinorhodin Gene I.

14. A method according to claim 9 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of a gene involved in the biosynthesis of milbemycin.

15. A method according to claim 14 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of milbemycin Gene III.

16. A method according to claim 14 wherein said nucleic acid probe comprises the nucleic acid sequence of at least a part of milbemycin Gene I.

17. A method according to claim 9 wherein said naturally non-producing strain of a bacterium of the genus *Streptomyces* is selected from the group of strains consisting of strains of *Streptomyces lividans*, strains of *Streptomyces ambofaciens*, strains of *Streptomyces coelicolor* and strains of *Streptomyces avermitilis*.

18. A method according to claim 9 wherein said first polyketide antibiotic is a milbemycin.

19. A method according to claim 18 wherein said naturally non-producing strain of a bacterium of the genus *Streptomyces* is a strain of *Streptomyces lividans*. 20. A method according to claim 9 wherein said first polyketide antibiotic is an avermectin.

21. A method according to claim 20 wherein said naturally non-producing strain of a bacterium of the genus *Streptomyces* is a strain of *Streptomyces lividans*.

22. A method for producing a milbemycin in a naturally non-milbemycin producing strain of a bacterium of the genus *Streptomyces* which comprises introducing into said non-producing strain a DNA fragment which comprises the DNA fragment MC.

23. A method according to claim 22 wherein said naturally non-milbemycin producing strain is a strain of *Streptomyces lividans*. 24. A method for activating expression of a polyketide antibiotic biosynthetic gene

cluster in a bacterial strain of the genus *Streptomyces* which strain contains the biosynthetic genes sufficient for production of said polyketide antibiotic but lacks a functional polyketide antibiotic biosynthesis activator gene

which comprises introducing into said bacterial strain a DNA fragment which comprises milbemycin Gene II.

25. A method according to claim 24 wherein said bacterial strain is a strain of *Streptomyces lividans*. 26. A method according to claim 25 wherein said polyketide antibiotic is actinorhodin.

27. A method according to claim 24 wherein said bacterial strain is a strain of *Streptomyces coelicolor* and said polyketide antibiotic is actinorhodin.

28. A method according to claim 24 wherein said bacterial strain is a strain of *Streptomyces avermitilis* and said polyketide antibiotic is an avermectin.

29. A vector which comprises a DNA fragment consisting essentially of the milbemycin biosynthetic gene cluster.

30. A bacterial strain containing the vector of claim 29.

31. A vector according to claim 30 wherein said DNA fragment is the fragment MC.

32. A bacterial strain containing the vector of claim 31.

33. A vector which comprises a DNA molecule consisting essentially of the DNA

Page 1265

sequence encoding a milbemycin gene selected from the group consisting of milbemycin Gene I, milbemycin Gene II, and milbemycin Gene III.

34. A bacterial strain containing the vector of claim 33.

35. A vector according to claim 29 wherein said DNA fragment is a DNA fragment selected from the group of DNA fragments consisting of fragment 1, fragment 2, fragment 3, fragment 4, fragment 5, fragment 6, fragment 7, fragment 8a, fragment 8b, fragment 10, fragment 12, fragment 14, fragment 16, fragment 62, and fragment 64.

36. A bacterial strain containing the vector of claim 35.

37. A hybridization probe molecule consisting essentially of milbemycin biosynthetic gene cluster.

38. A hybridization probe molecule that is fragment MC.

39. A hybridization probe consisting essentially of the DNA sequence encoding a milbemycin gene selected from the group of milbemycin genes consisting of milbemycin Gene I, milbemycin Gene II and milbemycin gene III.

40. A hybridization probe that is a DNA fragment selected from the group of DNA fragments consisting of fragment 1, fragment 2, fragment 3, fragment 4, fragment 5, fragment 6, fragment 7, fragment 8a, fragment 8b, fragment 10, fragment 12, fragment 14, fragment 16, fragment 62, and fragment 64.

41. A hybridization probe, the sequence of which is derived from the sequence of a fragment selected from the group of fragments consisting of fragment 1, fragment 2, fragment 3, fragment 4, fragment 5, fragment 6, fragment 7, fragment 8a, fragment 8b, fragment 10, fragment 12, fragment 14, fragment 16, fragment 62, and fragment 64.

42. A DNA fragment selected from the group of DNA fragments consisting of fragment 1, fragment 2, fragment 3, fragment 4, fragment 5, fragment 6, fragment 7, fragment 8a, fragment 8b, fragment 10, fragment 12, fragment 14, fragment 16, fragment 62, fragment 64 and fragment MC.

Footnotes

Footnote 1. The examiner's consideration of this reference appears to be based upon appellants' summary thereof on page 2, lines 20-29 of the specification. We have considered the original reference as it was provided by appellants on October 31, 1991 (Paper No. 25).

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Footnote 2. As the record now stands, Malpartida 1986 is prior art to the claims on appeal. Appellants have not submitted copies of the two United Kingdom documents priority of which is claimed in the original declaration of this application under 35 USC Section 119. Therefore, the examiner has not determined whether any of the claims on appeal enjoy the benefit of the earlier filing date of either of these documents.

Footnote 3. See, e.g., Malpartida 1987, Horinouchi, and Lydiate.

Footnote 4. Appellants have not established on this record that Motamedi is available evidence for establishing enablement of these claims since it was published after the present filing date. *In re Glass, supra*.

Footnote 5. We note that claim 31 is improperly dependent on claim 30. This matter should also be addressed if prosecution is continued on this subject matter in a continuing application.

Footnote 1. Our attribution of the citation of *In re Glass*, 492 F.2d 1228, 181 USPQ 31 (CCPA 1974), to the examiner at pages 12-13 of our opinion was inadvertent. We cited that case in support of the examiner's position that subsequently published references such as Hallam are not available for use as appellants have done herein. Again, we decline to decide the specific issue since even if Hallam is considered as available for this purpose, claims 4 and 12 are of a much broader scope than recognized by appellants' arguments.

- End of Case -

EXHIBIT I

FULL TEXT OF CASES (USPQ FIRST SERIES)

In re RATTI

(CCPA)
123 USPQ 349
Decided Sept. 30, 1959
Appl. No. 6452
U.S. Court of Customs and Patent Appeals

Headnotes**PATENTS****1. Evidence—Judicial notice (§ 36.20)**

It is common knowledge that resilient deformable materials such as natural or synthetic rubber are incompressible, i.e., while they may be deformed, this can occur only if design and mounting of part permits resilient material to change its shape in response to applied forces.

2. Patentability — Anticipation — Combining references (§ 51.205)**Patentability — Anticipation — Modifying references (§ 51.217)**

Combination of J patent with C patent is not proper ground for rejection of claims since combination would require substantial reconstruction and redesign of elements shown in C as well as change in basic principles under which C construction was designed to operate; once applicant taught how this could be done, redesign may, by hindsight, seem to be obvious to one having ordinary skills in art, but, when viewed as of time applicant's invention was made, and without benefit of applicant's disclosure, court finds nothing in art of record which suggests applicant's novel device.

3. Court of Customs and Patent Appeals—Issues determined—Ex parte patent cases (§ 28.203)

Rejection reversed by Board is not before court.

4. Patentability—In general (§ 51.01)

Novelty alone is not enough for patentability.

5. Patent grant—In general (§ 50.01)

Applicant is entitled to patent, under the statutes, unless one of the prohibitory provisions of statutes applies.

6. Patentability—In general (§ 51.01)**Patentability—Evidence of—In general (§ 51.451)****Patentability—Utility (§ 51.75)**

Statutory requirements for patentability are novelty, usefulness, and unobviousness, as provided in 35 U.S.C. 101, 102, and 103; while proof that invention is better or possesses advantages may be persuasive of existence of any one or all of the requirements, and hence be indicative of patentability, Congress has not made such proof a prerequisite to patentability; moreover, Congress has never required that each and every patentable invention involve "progress" in the sense that it must possess some definite advantage over prior art; hence, it is improper to reject claim on ground that it does not possess some definite advantage over prior art; while R.S. 4893 may be said to have given Commissioner some discretion in refusing to grant patent on an otherwise patentable invention unless "the same is sufficiently useful and important," Congress removed this provision from new 35 U.S.C. 131; this is further indication that it is intent of Congress that patentability be determined solely by sections 101, 102, and 103.

7. Court of Customs and Patent Appeals—In general (§ 28.01)**Pleading and practice in Patent Office—In general (§ 54.1)**

It is duty of Patent Office and Court of Customs and Patent Appeals to apply law as Congress wrote it.

Particular patents—Oil Seal

Ratti, Oil Seal, claims 1, 4, 7, and 10 of application allowed.

Case History and Disposition:

Page 349

Appeal from Board of Appeals of the Patent Office.

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Application for patent of Ferdinand J. Ratti, Serial No. 359,325, filed June 3, 1953; Patent Office Division 52. From decision rejecting claims 1, 4, 7, and 10, applicant appeals. Reversed; Kirkpatrick, Judge, dissenting with opinion in which Worley, Chief Judge, joins.

Attorneys:

CROMWELL, GREIST & WARDEN (RAYMOND L. GREIST of counsel) both of Chicago, Ill., for appellant.

CLARENCE W. MOORE (S. WM. COCHRAN of counsel) for Commissioner of Patents.

Judge:

Before WORLEY, Chief Judge, RICH, MARTIN, and SMITH, Associate Judges, and KIRKPATRICK, Judge *.

Opinion Text

Opinion By:

SMITH, Judge.

This is an appeal from the decision of the Board of Appeals of the United States Patent Office affirming the rejection by the Primary Examiner of claims 1, 4, 7 and 10 of appellant's application serial No. 359,325, filed June 3, 1953, for a patent on an "Oil Seal" for sealing the space between a bore in a housing and a relatively movable shaft centrally located in the bore.

Page 350

Claim 1 is representative of claims 4 and 7 and reads:

1. A seal for insertion in a cylindrical bore in a housing about a relatively movable centrally located shaft, comprising an annular bore-engaging mounting portion of resiliently deformable material for endwise insertion in and statically sealed engagement with the bore in the housing, an annular shaft-engaging portion connected with said bore-engaging portion for running engagement with the shaft, and a *metal ring* located adjacent one end of said bore-engaging portion, said ring being *provided with a plurality of axially extending outwardly biased spring fingers in outwardly clamped engagement with said bore-engaging portion inwardly of the outer periphery of the latter, and said ring being also provided outwardly of said bore-engaging portion with means for detachably connecting the ring to the housing* outwardly of the bore in the latter. (Emphasis ours.)

Claim 10 differs from the other claims on appeal and reads:

10. A seal for insertion in a cylindrical bore in a housing about a relatively movable centrally located shaft, comprising a sealing ring having an outer bore-

engaging portion of resiliently deformable material, which portion is of somewhat larger diameter than the bore in the housing, for press-fit insertion in the bore, and a *metal retaining ring* associated with the sealing ring, said retaining ring being connected with the sealing ring and being provided outwardly of the latter *with resiliently yieldable hook formations which are adapted to be sprung into interlocking engagement with a complementary formation associated with the housing outwardly of the bore*, which engagement acts to prevent axial displacement of the sealing ring relative to the bore in the housing. (Emphasis ours.)

The references in the case are:

Roth, 1,546,942, July 21, 1925.

Norton, 1,951,034, Mar. 1, 1934.

Jepson, 2,544,324, Mar. 6, 1951.

Chinnery et al. (British), 578,526, July 2, 1946.

Appellant's shaft seal comprises an annular sealing member of resilient deformable material which is adapted to be inserted into a cylindrical bore surrounding a relatively movable shaft. The inner portion of the sealing member is provided with a flexible lip which is held in engagement with the shaft by a garter spring. In the outer portion of the sealing member, an annular slot is provided which is concentric with and spaced from the outer periphery of the sealing member. This slot extends axially from the end of the member and provides a pocket in which the axially extending outwardly biased spring fingers of a metallic attaching ring are located. This construction permits the spring fingers to exert a force on the resilient material in the direction of the annular wall of the bore to provide and maintain a snug engagement between the outer surface of the resilient member and the inner surface of the bore. The metallic attaching ring is also provided with radially extending resilient hooks located outwardly of the bore engaging portion of the resilient member. The housing is provided with a complementary formation outwardly of the bore which is engaged by the resilient hooks to provide a snap-on connection between the bore and the seal.

The Roth and Norton patents were relied upon by the examiner in rejecting claim 10, and since both references were considered by the board, we have included them in our consideration of this case. Roth shows a gasket structure for steam train line hose couplings. Norton shows an adjustable repair clamp for bell and spigot joints in which there is provided a sheet metal bridge piece "preferably of spring material." The bridge piece is sprung into interlocking engagement with a structural portion of the clamp and exerts its force on a resilient packing ring which, if desired, may be cemented to it.

The Chinnery et al. patent is the reference principally relied upon by the Patent Office. It shows a housing provided with a bore surrounding a centrally located shaft. A reinforced and "stiffened" sealing member formed of a material such as rubber, is press fitted into the space between the bore and the shaft. The sealing member has an inner lip held in contact with the shaft by a garter spring. The bore engaging portion of the sealing member is "stiffened" by an axially extending cylindrical sheet metal casing which acts as a reinforcing member for a definite purpose which is described by Chinnery et al. as follows:

Owing to the limited radial space within which the oil seal is to be

accommodated, the holding portion of the oil seal cannot be stiffened by being massive. Consequently the holding portion of the present oil seal is stiffened in the known manner by a reinforcement, which may either encase or line, or alternatively constitute, such holding portion and therefore makes the press-fitting contact with the machine part stationary relatively thereto, *or may be an internal reinforcement in the sense that it does not make press-*

Page 351

fitting contact with the machine part stationary relatively thereto. (Emphasis ours.)

In Fig. 8 Chinnery et al. shows a radially extending flange at the outer edge of a reinforcing member of the internal reinforcement type which flange extends beyond the sealing member "to such an extent as to serve as a means of attachment of the oil seal to the housing *i*, additional to the interference press fit of the holding portion *a* in the housing recess *g*." The aforesaid flange is shown attached to the housing by screws or bolts.

The Jepson patent relates to a gasket for sealing the space between the upper and lower vessels of a vacuum-type coffee maker. The gasket is an annular rubber member attached to the lower part of the upper vessel and is designed to fit into the upper part of the lower one. Located in a groove in the gasket is a sleeve member provided with axially and downwardly extending spring fingers which are so biased radially as to urge the lower peripheral portion of the gasket outwardly, thus effecting a tight engagement with the mouth of the lower vessel.

Claims 1, 4, and 7 stand rejected on Chinnery et al. in view of Jepson, on the ground that it would not require "invention" to replace the cylindrical sheet metal reinforcing member, which is secured to the Chinnery et al. sealing member, by an annular set of outwardly biased spring fingers shown by Jepson.

The problems which were solved by appellant's invention existed in this art at the time of his invention despite the Chinnery et al. disclosures. It was appellant rather than Chinnery et al. who provided the art with a shaft seal in which the resilient element of the seal could be readily inserted into a bore in the housing so that it could be removed from the bore and replaced by a new sealing element without mutilation of the sealing surface of the bore. This is particularly important, the specification points out, where the bore is formed in light metal alloys such as are used in aircraft engines and which are relatively soft and easily damaged. In appellant's oil seal, the resilient seal is so constructed that when mounted in the bore, it will establish and maintain a fluid tight relationship between the outer peripheral surface of the resilient seal member and the inside of the bore. Where either natural or synthetic rubber is used as the resilient sealing member in such seals, the rubber in time will take a set or lose its resiliency at least to the extent that the seals soon become ineffective to prevent leakage of oil. When subjected to mechanical pressures and heat, such a rubber sealing element loses its sealing effectiveness at an accelerated rate. The problems in the oil sealing art arising from such use of resilient sealing elements appear to have persisted because of the failure of the art to recognize these characteristics of the rubber sealing element and to so design the resilient element and the mounting

therefor as to assure holding the outer circumference of the resilient sealing element in static oil-sealing contact with the inner circumference of the bore in which it is inserted.

Appellant's seal differs from the art of record in at least three respects:

(1) The provision of the annular slot which extends axially inward from one end of the resilient sealing element. This feature is claimed as part of the combination set forth in claim 4.

(2) The outwardly biased resilient spring means or fingers inserted in the resilient sealing element. These means are claimed as part of the combination of claims 1, 4 and 7.

(3) The "snap-on" connector which holds the resilient sealing element and engages with a complementary formation associated with the housing outwardly of the bore. This feature is in the combination of claim 10.

The patents cited by the examiner, either alone or in combination, do not disclose a resilient shaft sealing element having these features.

[1] It is common knowledge that resilient deformable materials such as either natural or synthetic rubber are incompressible, that is, while they may be deformed, this can occur only if the design and mounting of the part permits the resilient material to change its shape in response to the applied forces.

The seal construction disclosed in Chinnery et al. is such that the "interference press fit" which that patent calls for is alone relied on to keep the seal tight. There is nothing in the Chinnery et al. patent to show how the resilient sealing element is *maintained* in resilient contact with the bore otherwise than by the resiliency of the rubber. If and when that resiliency is lost, the sealing effect will be impaired.

Considering the incompressible nature of the rubber in the sealing element disclosed in Chinnery et al., its stiffening and reinforcement by the cylindrical sheet metal member, and its "interference press fit" in the bore, it seems clear to us that the Chinnery et al. seal cannot function in the manner of appellant's seal. Now, as to the contention that Jepson would suggest inserting a set of spring fingers, the resilient element of Chinnery et al. is forced so tightly into the bore

Page 352

and is so "stiffened" that the use of the resilient spring fingers of Jepson could not possibly increase the resilient deformation of the Chinnery et al. seal in the direction of the bore or increase the sealing engagement of the seal with the bore. The teaching of the Chinnery et al. patent points away from the addition of any spring element. On the other hand, we find nothing in the disclosure of Jepson's coffee maker gasket to suggest that any part of it has applicability to shaft seals. The two arts are at least somewhat remote from each other even if they both involve sealing.

[2] We, therefore, find that Chinnery et al. did not teach the shaft sealing art how to solve the problems which existed in that art at the time of appellant's invention. We hold, further, that the combination of Jepson with Chinnery et al. is not a proper ground for rejection of the claims here on appeal. This suggested combination of references would require a substantial reconstruction and redesign of the elements shown in Chinnery et al. as well as a change in the basic principles under which the Chinnery et al. construction

was designed to operate.

Once appellant had taught how this could be done, the redesign may, by hindsight, seem to be obvious to one having ordinary skills in the shaft sealing art. However, when viewed as of the time appellant's invention was made, and without the benefit of appellant's disclosure, we find nothing in the art of record which suggests appellant's novel oil seal as defined in claims 1, 4 and 7.

We shall now consider the rejection of claim 10, remarking first that it differs from claims 1, 4 and 7 in that it is directed to a combination of a housing bore, a resilient sealing ring and a metal retaining ring connected to the sealing ring, wherein the metal ring has *resilient hooks* which secure the seal in the bore. This claim is not limited to the outwardly biased spring fingers.

The examiner rejected claim 10 on two grounds: (1) that substitution for the screw securing means of Chinnery et al. of a series of spring hooks such as disclosed by Norton would not involve patentable invention, and (2) unpatentability over Roth.

[3] We shall first dispose of the second rejection. The board held that claim 10 is drawn to a combination of a sealing ring and a housing bore in which the sealing ring is detachably placed and that Roth discloses nothing of this nature. The board therefore reversed the rejection on Roth and consequently it is not before us.

As to the first rejection, the board recognized that it was on the ground of unpatentability "over Chinnery et al. in view of Norton" and pointed out that the examiner could see nothing patentable in substituting spring hook attaching means shown in Norton for the screws of Chinnery et al. It then said:

Appellant argues that the references fail to suggest or teach how the proposed [claimed] combination could be made and after a careful consideration of the references, *we have concluded that he is correct in this respect. We therefore concede that the claim * * * defines novelty over the disclosure of Fig. 8 of Chinnery et al.* Novelty alone however, is no proper basis for the allowance of a claim. (Emphasis ours.)

[4] Although, in reaching this conclusion, the board made no reference to Norton, the context compels the conclusion that novelty was found notwithstanding the disclosure of Norton, taken together with Chinnery et al. We fully agree, of course, with the board's statement that novelty alone is not enough for patentability.

With the next statement of the board, in explanation of its affirmance of the rejection of claim 10, we do not agree. It reads:

In order to *properly* define invention [meaning, of course, *patentable* invention], a claim should clearly define a structure *which possesses some definite advantage over the prior art*. As far as we can determine there is *no better* combination of housing and seal produced by using a series of snap fastener connections to connect the seal to the housing, as in appellant's structure, over using a series of bolts, as in the structure shown by Chinnery et al. Both act to merely detachably connect one element to another element and as far as we can find are merely equivalent connecting means especially in the absence of any unexpected result or *advantage* being obtained, by using one means in preference to the other, on which the record before us is entirely silent. (Emphasis ours.)

If we may extract from the foregoing what we understand to be the essence of the board's

position in the matter, it is that claim 10 is not patentable, though it defines a combination which is novel over the disclosures of the references, because the claimed combination has not been shown to be any better than, or to possess any advantage over, what was known to the art.

[5][6] As was pointed out in *In re Stempel, Jr.*, 44 CCPA 820, 241 F.2d 755, 113 USPQ 77 , an applicant is entitled to a patent, under the statutes, unless one of the prohibitory provisions of the statutes applies. The statutory requirements

Page 353

for patentability, broadly stated, are novelty, usefulness and unobviousness, as provided in 35 U.S.C. sections 101, 102, and 103. While it is true that proof that an invention *is* better or *does* possess advantages may be persuasive of the existence of any one or all of the foregoing three requirements, and hence be indicative of patentability, Congress has not seen fit to make such proof a prerequisite to patentability.¹

[7]Appellant's invention, as defined in claim 10, has been held by the board to possess novelty over the disclosure of Chinnery et al. Just what the board thought about the pertinency of Norton is obscure but it seems to have regarded this reference as of little moment. Appellant in his brief here said that Norton was held by the board to have no bearing on the invention and the Patent Office brief said that the appellant was correct in so stating and that the court need not consider it. We are, therefore, virtually without any reference against claim 10 except Chinnery et al. and the rejection thereon is predicated solely on a theory of patentability we find to be outside of the patent statutes, namely, that the combination of claim 10 is, by reason of the use of spring retaining hooks instead of a series of bolts, *no better* than the combination of Chinnery et al. However intriguing such a ground of rejection may be, it is the duty of the tribunals of the Patent Office and of this court to apply the law as Congress has written it. While the provisions of the formerR.S. 4893 may be said to have given the Commissioner some discretion in refusing to grant a patent on an otherwise patentable invention unless "the same is sufficiently useful and important," when the Patent Codification Act of 1952 was enacted, Congress removed this provision from old section 36 of title 35, now section 131. We take this as a further indication that it is the intent of Congress that patentability be determined solely by the provisions of sections 101, 102 and 103. We therefore reverse the board on this ground of rejection of claim 10.

If the issue before us were whether or not the spring hooks *are* better than the Chinnery et al. bolts—and we consider this in the event we have misapprehended the position of the board—we would hold that they are, on the basis of what is disclosed in the application. This retaining means seems to possess many advantages over screws. Similarly, if the board was intending to say that the hooks and the bolts are merely equivalent connecting means and that claim 10 is unpatentable because its combination differs from the prior art only in the substitution of an equivalent for one element in an old combination, then we would also have to disagree since we think it is clear that the use of the spring hooks produces a result quite different from the bolts of Chinnery et al. On the record before us no reference relied on shows any spring hooks nor does it contain any support for the contention that bolts and spring hooks are equivalents.

For the foregoing reasons we reverse the rejection of claim 10.
The rejections of claims 1, 4, 7 and 10 are *reversed*.

Footnotes

Footnote 1. A critical essay on the existing law has recently appeared under the title "A Proposal for: A Standard of Patentability; Consonant Statutory Changes; A Manual on Determination of Patentability," by Malcolm F. Bailey, 41 J.P.O.S. 192-225, 231-257. It advocates, as we understand it, that the present law should be changed to set up as the test for patentability, in place of the requirement of section 103 that an invention be unobvious, a requirement that the invention involve *progress*, which the author finds in the constitutional provisions. Congress has not seen fit to include in the statutes, at any time during the past 169 years so far as we are aware, a requirement that each and every patentable *invention* shall involve "progress" in this sense, i.e., that each new invention must also be shown to possess some definite advantage over the prior art. The author relates the term "progress" to individual inventions and then gives it the connotation that each such invention should be a technical advance, improvement or betterment. The very making of the suggestion to change the law is an indication that the existing law is otherwise.

Concurring Opinion Text

Concur By:

MARTIN, Judge, concurs in result.

Dissenting Opinion Text

Dissent By:

KIRKPATRICK, Judge, dissenting, in which WORLEY, Chief Judge, joins.

I think that the board's rejection of claims 1, 4 and 7 should be affirmed. The central idea and the most important feature of these three claims, as well as of allowed claim 5, is the exertion of outwardly directed pressure upon the bore engaging portion of the sealing member, the result accomplished being to counteract the tendency of rubber to "set" or lose its resiliency and so become ineffective to prevent leakage. Jepson comes very close to completely anticipating this feature of the patent. All that would be necessary to make the anticipation complete would be to provide the Jepson seal with a shaft engaging portion and, incidentally, claim 7 does not specify any shaft engaging portion.

Of course, it was necessary that the seal be attached to the bore in a manner to prevent its displacement. Chinnery provides a flange and screws for this purpose and none of the three claims referred to calls for anything more specific than "means." Thus it seems clear that

claims 1, 4 and 7 show no patentable novelty as against the prior art of Chinnery plus Jepson.

The only question is whether Jepson is in a nonanalogous art sufficiently remote from that of the application to put it beyond the probability that it would be considered by persons skilled in the art endeavoring to solve the problem to the solution of which the application is directed. I do not think that it is. Jepson was trying to meet exactly the same problem as the application under consideration, namely, to provide a compressible seal which could be readily detached or inserted in a cylindrical bore but which would maintain a firm and leakproof seat on the bore when in place. I agree with the Solicitor's argument that one seeking to improve a machinery seal would reasonably be expected to investigate not only machinery seals but seals in other arts where similar problems would be encountered. See *In re O'Connor*, 34 CCPA 1055, 161 F.2d 221, 73 USPQ 433 .

Claim 10 stands on a somewhat different basis. This claim entirely omits what I think, and have stated above, to be the heart of the application. In substance, claim 10 really amounts to no more than a claim for a hook formation to interlock with the housing of a bore in order to hold a press fit seal in place.¹ Chinnery discloses means to serve the same purpose consisting of screws.

The board conceded that the combination disclosed in claim 10, consisting of spring hooks to fasten a press fit seal to the bore, disclosed novelty over Chinnery but not patentable novelty.

I do not read the opinion of the board as predicating its conclusion of want of invention on the theory that in order to be patentable a combination must have some distinct advantage over the prior art. The board stated that there was nothing in the record to show that the substitution of hooks for screws produced any unexpected result or advantage and, therefore, concluded that the introduction of hooks did not create patentable novelty, but was a mere substitution of equivalents. The statement that the spring hooks of Ratti were no better than the screws of Chinnery was directed toward this point and seemingly was added to fortify the board's finding of equivalency rather than to propound a theory of patentability. I agree with the board that this claim, though it may show novelty over Chinnery, does not show patentable novelty, and I would affirm its rejection.

Footnotes

Footnote 1. Chinnery discloses a press fit seal, but no one has suggested that there is anything new about such a device and the specification of the application before us concedes that it is old in the art.

Footnote * United States Senior District Judge for the Eastern District of Pennsylvania, designated to participate in place of Judge O'CONNELL, pursuant to the provisions of Title 28, United States Code, Section 294(d).

- End of Case -

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EXHIBIT J

NOTE: Pursuant to Fed. Cir. R. 47.6, this disposition is not citable as precedent. It is a public record.

United States Court of Appeals for the Federal Circuit

04-1225
(Serial No. 07/636,839)

IN RE BRUCE BEASLEY

DECIDED: December 7, 2004

Before LOURIE, Circuit Judge, ARCHER, Senior Circuit Judge, and DYK, Circuit Judge.

Opinion for the court filed by Circuit Judge LOURIE. Dissenting opinion filed by Circuit Judge DYK.

LOURIE, Circuit Judge.

Bruce Beasley appeals from the decision of the United States Patent and Trademark Office ("PTO") Board of Patent Appeals and Interferences affirming the rejection of claims 1-6 of U.S. Patent Application 07/636,839 as obvious under 35 U.S.C. § 103. Ex parte Beasley, Appeal No. 2001-2202, Paper No. 38 (B.P.A.I. Aug. 29, 2002) ("Decision on Appeal"); Ex parte Beasley, Appeal No. 2001-2202, Paper No. 40 (B.P.A.I. Oct. 27, 2003) ("Decision on Request for Rehearing"). Because the Board's key factual findings relating to its obviousness analysis are not supported by substantial evidence, the Board erred in concluding that the claims would have been obvious as a matter of law. We accordingly vacate and remand.

BACKGROUND

On January 2, 1991, Beasley filed U.S. Patent Application 07/636,839 directed to the generation of images or markings on a video display screen using a light pen, so as to point to or otherwise indicate information of interest. Representative claim 1 recites:

1. In a system for forming an image on a display screen scanned in frames by a beam:
 - a light pen movable relative to the screen and having a light sensing element for providing a signal when the position of the light pen coincides with the position of the beam,
 - a memory having a plurality of addressable storage locations,
 - means for mapping the display screen into the memory on a point-by-point basis by sequentially addressing the memory locations in synchronization with the position of the beam to provide a one-to-one correspondence between the memory locations and the points on the screen,
 - means responsive to the signal from the light pen for writing data into the memory at locations corresponding to the position of the light pen on the screen during successive frames,
 - means for reading the data out of the memory locations as they are addressed, and
 - means responsive to the data read out of the memory for producing an image corresponding to the points where the light pen is positioned during successive frames.

(emphases and paragraphing added).

Previously, the '839 application had been the subject of an appeal to this court, which affirmed the rejection of claims 1-6 under 35 U.S.C. §§ 102 and 103 in view of U.S. Patent 3,832,485 ("Pieters"). In re Beasley, No. 99-1055, 1999 WL 515480 (Fed. Cir. July 20, 1999) (nonprecedential) ("Beasley I").¹ Beasley thereafter filed a Continued Prosecution Application, in which he amended independent claims 1 and 4 to

¹ In Beasley I, claims 1, 3, 4, and 6 had been rejected as being anticipated by Pieters, and claims 2 and 5 had been rejected as being obvious in view of the same. Beasley I, 1999 WL 515480 at **1. Pieters is directed to an apparatus for creating delineations on images using, inter alia, a light pen. Pieters, abstract.

specifically include the feature of “mapping the display screen into the memory on a point-by-point basis . . . to provide a one-to-one correspondence” between the memory locations and the points on the screen (hereinafter referred to as the “point-by-point mapping limitation”).²

Observing that Pieters, by itself, did not disclose the point-by-point mapping limitation, the examiner rejected the amended claims for obviousness under § 103 in view of Pieters combined with either one of U.S. Patent 3,973,245 (“Belser”) or U.S. Patent 4,847,604 (“Doyle”).³ The examiner cited Belser and Doyle as each disclosing “a conventional bit map memory mapping a display screen into the memory on a point by point basis,” and that “it would have been obvious to one of ordinary skill in the art to substitute Belser’s [or Doyle’s] bit map memory” for the content addressable memory (“CAM”) used in Pieters. Jan. 7, 2000 Office Action at 2-3. A skilled artisan would have been motivated to make such a combination, alleged the examiner, “because image data stored in the bit map format can be read out rapidly.” Id.

² In the prior appeal, Beasley argued that the point-by-point mapping limitation was to be read into independent claims 1 and 4, in an attempt to avoid anticipation by Pieters. The court in Beasley I concluded that the language of the claims was not sufficiently narrow to require this limitation to be read therein, and consequently affirmed the anticipation rejection. Beasley I, 1999 WL 515480 at **3. After amending the claims to expressly recite the point-by-point mapping limitation, Beasley is now before us again. Although the point-by-point mapping limitation is cast in means-plus-function form, see 35 U.S.C. § 112, ¶ 6 (2000), the parties do not dispute whether any of the cited references discloses an equivalent structure. Accordingly, we need not identify or consider the structures in Beasley’s application that correspond to that function.

³ Belser concerns a method and apparatus for “converting information in coded form into a dot matrix or raster form,” Belser, col. 2, ll. 22-24, and presents in considerable detail an algorithm for reformatting data. Belser, col. 5, l. 23 through col. 9, l. 20. Doyle is directed to a system that allows a user to point to a feature on an image and cause descriptive information (e.g., text or a magnified view) to appear. Doyle, col. 11, l. 13 through col. 12, l. 18.

Beasley responded that the examiner had failed to establish a prima facie case of obviousness because replacing the CAM in Pieters with the memories in Belser and Doyle would require “a complete restructuring” of the system shown in Pieters, which was “not within the purview of obviousness.” Apr. 6, 2000 Resp. to Office Action at 2. Arguing that the cited references failed to provide any motivation for the combination, Beasley stressed that the examiner’s suggestion for the substitution “appear[ed] to be based entirely on applicant’s own disclosure” in an attempt to “piece together” the prior art so as to render the claimed invention obvious. Id. Beasley criticized the rationale proffered by the examiner—that “data stored in a bit map format can be read out rapidly”—as “fall[ing] far short of the necessary motivation for the combination.” Id.

The examiner rejected Beasley’s arguments in a final office action, by repeating the substance of the Jan. 7, 2000 Office Action, and by further alleging that it was “well known in [the] computer display art to substitute a bit map memory for a conventional memory such as the memory used by Pieters.” Jun. 14, 2000 Office Action at 4. Insisting that the “advantage of using . . . bit map memory over . . . conventional memory [was] well recognized,” the examiner listed three advantages: (1) increasing the display rate; (2) ensuring proper correlation of image locations with display locations; and (3) minimizing data processing and storage requirements. Id. In view of those “well recognized” advantages, reasoned the examiner, “it would have been obvious to one of ordinary skill” to make the substitution. Id. at 5.

Beasley appealed the final rejection to the Board, reiterating his arguments against obviousness. The Board agreed with the examiner's reasoning and affirmed⁴ the rejection of claims 1-6.⁵ Decision on Appeal at 8. The Board found that the cited references suggested to skilled artisans "that if more rapid readout of image data is desired, the bit map memory, rather than the CAM of Pieters, should be employed." Id. at 5-6. With respect to Beasley's restructuring argument, the Board stated that "the artisan skilled in the image display and memory arts would have been well aware of the restructuring" involved when making the substitution. Id. at 6. Disagreeing with Beasley that the examiner's proposed substitution of one memory type for another was "unsupported," the Board reasoned that the "artisan would clearly have understood, from the applied references, the different types of memories available (CAM versus bit map), and their comparative advantages, and would have chosen implementation of one over the other for the advantages sought." Id. Concluding that the examiner established a prima facie case of obviousness, the Board sustained the rejection of claims 1-6.

Beasley filed a request for reconsideration, which the Board denied. Decision on Request for Rehearing at 5. Beasley timely appealed the Board's decision to this court, and we have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A).

⁴ To the extent the Board adopted the examiner's position as its own, we shall refer to the examiner's findings and conclusions as those of the Board. See In re Paulsen, 30 F.3d 1475, 1478 n.6 (Fed. Cir. 1994).

⁵ Our discussion will focus on independent claim 1, and, in particular, the point-by-point mapping limitation. The only other independent claim is claim 4, which is directed to a method, but is otherwise similar to independent claim 1 in all material respects. Since Beasley has not made separate patentability arguments for claim 4, or for any of the dependent claims, those claims will stand or fall together with claim 1. See In re Kaslow, 707 F.2d 1366, 1376 (Fed. Cir. 1983).

DISCUSSION

A claimed invention may be found to have been obvious "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." 35 U.S.C. § 103(a) (2000). Whether an invention would have been obvious under § 103 is a question of law based on underlying findings of fact. In re Kotzab, 217 F.3d 1365, 1369 (Fed. Cir. 2000). We review the Board's legal conclusion of obviousness de novo, and its underlying factual determinations for substantial evidence. In re Gartside, 203 F.3d 1305, 1316 (Fed. Cir. 2000). Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." Id. at 1312 (quoting Consolidated Edison Co. v. NLRB, 305 U.S. 197, 229 (1938)).

On appeal, Beasley urges reversal on the basis that the record does not support the Board's determination that the examiner established a prima facie case of obviousness. For a prima facie case of obviousness to exist, there must be "some objective teaching in the prior art or . . . knowledge generally available to one of ordinary skill in the art [that] would lead that individual to combine the relevant teachings of the references." In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). "The motivation, suggestion or teaching may come explicitly from statements in the prior art, the knowledge of one of ordinary skill in the art, or, in some cases the nature of the problem to be solved." Kotzab, 217 F.3d at 1370.

The presence or absence of a motivation to combine references is a question of fact, In re Dembiczkak, 175 F.3d 994, 1000 (Fed. Cir. 1999), which is evaluated under

the substantial evidence standard. Gartside, 203 F.3d at 1316. Beasley contends that we have before us a case of impermissible hindsight reconstruction, in which the examiner's finding of a motivation to substitute the memory used in either Belser or Doyle for the CAM in Pieters rests on generalized statements of advantages without regard to the desirability or the feasibility of modifying Pieters. Given the "subtle but powerful attraction of a hindsight-based obviousness analysis," we require a "rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." Dembiczak, 175 F.3d at 999. This is consonant with the obligation of the Board to develop an evidentiary basis for its factual findings to allow for judicial review under the substantial evidence standard that is both deferential and meaningful.

See In re Lee, 277 F.3d 1338, 1344 (Fed. Cir. 2002).

In evaluating the Board's finding of motivation, we look to the record, for "all of the relevant information upon which the Board relied in rendering its decision." Gartside, 203 F.3d at 1314. "That record, when before us, is closed, in that the Board's decision must be justified within the four corners of that record." Id. For the purposes of the present appeal, the record indicates that there have been no less than five occasions, since the filing of the Continued Prosecution Application with the amended claims, on which the Board and the examiner have had the opportunity to develop a factual record that establishes substantial evidence of a motivation to combine Pieters with either Belser or Doyle. They failed to do so in each instance. Our review of (1) the Jan. 7, 2000 Office Action; (2) the Jun. 14, 2000 Office Action; (3) the Feb. 13, 2001 Examiner's Answer; (4) the Decision on Appeal; and (5) the Decision on Request for Rehearing reveals that the assertions pertaining to the advantages of one type of

memory over another that had been advanced by the examiner and the Board for the express purpose of showing motivation for the proposed substitution have been set forth without any supporting citations to relevant portions of either Pieters, Belser, Doyle, or any other authority.

For example, the examiner's allegation in the Jan. 7, 2000 Office Action that "image data stored in the bit map format can be read out rapidly" has been repeated axiomatically throughout the record in justifying the replacement of the CAM in Pieters. Neither the Board nor the examiner has identified in the record any source of information—either from the references cited or otherwise—from which they base their comparison of the relative speed advantages of "bit map memories" over CAMs. Similarly, the assertion in the Jun. 14, 2000 Office Action that the "advantage of using . . . bit map memory over . . . conventional memory is well recognized" appears unaccompanied by any indication of its origins.⁶

In adopting the examiner's position, the Board made no effort to substantiate the examiner's assertions by invoking any identifiable authority. Instead, the Board relied on the examiner's and its own knowledge as skilled artisans. For example, the Board claimed that "the secondary references" suggested to skilled artisans "that if more rapid readout of image data is desired, the bit map memory, rather than the CAM of Pieters,

⁶ While the abstract of Doyle was cited for the proposition that the use of "bit map memory" ensures proper correlation of image locations with display locations, and minimizes data processing and storage requirements, a closer inspection of Doyle reveals that these "advantages" arise out of a specific arrangement for encoding image information, rather than from any intrinsic characteristic of "bit map memories" in general. Doyle, col. 4, ll. 15-19 ("[T]he advantages . . . stem from encoding information about a video image as a pixel bit map and a color map in which the addresses or indices of the color map are correlated with the addresses or pointers to strings of descriptive information about predefined features of the video image.").

should be employed." Decision on Appeal at 5-6. Similarly, in dismissing Beasley's restructuring argument, the Board alleged that a skilled artisan would have been "well aware" of the restructuring involved. Id. at 6. Under the MPEP provisions⁷ in effect at the time, such generalized claims of what "the secondary references" teach and of what the skilled artisan would have been "well aware" fail to satisfy the level of specificity that is required. Cf. Kotzab, 217 F.3d at 1371 ("[P]articular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed."). The MPEP provides guidelines for relying on official notice and personal knowledge, which the examiner did not follow in this case:

The rationale supporting an obviousness rejection may be based on common knowledge in the art or "well-known" prior art. The examiner may take official notice of facts outside of the record which are capable of instant and unquestionable demonstration as being "well-known" in the art. In re Ahlert, 424 F.2d 1088, 1091, 165 USPQ 418, 420 (CCPA 1970) . . .

. . . When a rejection is based on facts within the personal knowledge of the examiner, the data should be stated as specifically as possible, and the facts must be supported, when called for by the applicant, by an affidavit from the examiner. Such an affidavit is subject to contradiction or explanation by the affidavits of the applicant and other persons. See 37 CFR 1.104(d)(2).

. . . For further views on official notice, see In re Ahlert, 424 F.2d 1088, 1091, 165 USPQ 418, 420-421 (CCPA 1970) ("[A]ssertions of technical facts in areas of esoteric technology must always be supported by citation of some reference work" and "allegations concerning specific 'knowledge'

⁷ The Manual of Patent Examining Procedure ("MPEP") is commonly relied upon by patent examiners on procedural matters. Litton Sys., Inc. v. Whirlpool Corp., 728 F.2d 1423, 1439 (Fed. Cir. 1984). "While the MPEP does not have the force of law, it is entitled to judicial notice as an official interpretation of statutes or regulations as long as it is not in conflict therewith." Molins PLC v. Textron, Inc., 48 F.3d 1172, 1180 n.10 (Fed. Cir. 1995).

of the prior art, which might be peculiar to a particular art should also be supported.” . . .

MPEP § 2144.03 (7th ed. 1998) (emphases added); see also MPEP § 2144.03 (7th ed., rev. 1, 2000). Certainly, the relative speed advantages of CAMs vis-à-vis “bitmap memories” and the feasibility of substituting one for the other can hardly be described as a fact that is of “instant and unquestionable demonstration” for the purpose of taking official notice unsupported by any citation.

The record reflects that the examiner and the Board have managed to find motivation for substituting one type of memory for another without providing a citation of any relevant, identifiable source of information justifying such substitution. The statements made by the Examiner, upon which the Board relied, amount to no more than conclusory statements of generalized advantages and convenient assumptions about skilled artisans. At least under the MPEP then in effect, such statements and assumptions are inadequate to support a finding of motivation, which is a factual question that cannot be resolved on “subjective belief and unknown authority.” Lee, 277 F.3d at 1344. Under such circumstances, with respect to core factual findings, “the Board must point to some concrete evidence in the record in support” of them, rather than relying on its assessment of what is “well recognized” or what a skilled artisan would be “well aware.” In re Zurko, 258 F.3d 1379, 1385-86 (Fed. Cir. 2001). “To hold otherwise would render the process of appellate review for substantial evidence on the record a meaningless exercise.” Id. at 1386 (citing Baltimore & Ohio R.R. Co. v. Aberdeen & Rockfish R.R. Co., 393 U.S. 87, 91-92 (1968)).

The PTO, perhaps realizing the deficiencies in the record in this regard, provides numerous citations in its brief to specific passages in Pieters, Belser, and Doyle in a

valiant attempt to muster substantiation for the Board's findings. We cannot consider such post hoc attempts at bolstering the record in our review for substantial evidence. Burlington Truck Lines, Inc. v. United States, 371 U.S. 156, 168 (1962) ("[C]ourts may not accept appellate counsel's post hoc rationalization for agency action."). Our review must be limited to those grounds relied on and articulated by the Board; otherwise, the applicant may be deprived of a fair opportunity to support his position. See Lee, 277 F.3d at 1345; see also SEC v. Chenery Corp., 332 U.S. 194, 196 (1947) ("[T]he court is powerless to affirm the administrative action by substituting what it considers to be a more adequate or proper basis.").

CONCLUSION

For the above reasons, we conclude that the Board's determination that Beasley's claimed invention would have been obvious in view of the combination of Pieters with either Belser or Doyle is not supported by substantial evidence. Accordingly, we vacate the Board's decision and remand for further proceedings not inconsistent with this opinion.

NOTE: Pursuant to Fed. Cir. R. 47.6, this disposition
is not citable as precedent. It is a public record.

United States Court of Appeals for the Federal Circuit

04-1225
(Serial No. 07/636,839)

IN RE BRUCE BEASLEY

DYK, Circuit Judge, dissenting.

I respectfully dissent. Under our decision in Lee the Board may not rely on common knowledge and common sense in rejecting a claim as obvious. In re Lee, 277 F.3d 1338, 1344-45 (Fed. Cir. 2002). But both the examiner and the Board are presumed to be skilled in the art, id. at 1345, as the majority recognizes, ante at 8. They may properly rely on that knowledge in making rejections for obviousness, but "when they rely on what they assert to be general knowledge to negate patentability, that knowledge must be articulated and placed on the record." Lee, 277 F.3d at 1345.

That is exactly what the examiner and Board have done here. The patent examiner rejected Beasley's claims as obvious over Pieters in view of either Besler or Doyle, finding a motivation to combine in the fact that "image data stored in the bit map format can be read out rapidly." Jan. 7, 2000 Office Action at 2. The examiner sustained his rejection in the subsequent Office Action and specifically addressed Beasley's argument that there was no motivation to combine. The examiner noted that "[t]he advantage of using the bit map memory over the conventional memory is well recognized" and listed three advantages: (1) increasing the display rate; (2) ensuring proper correlation of image locations with display locations; and (3) minimizing data processing and storage requirements. June 14, 2000 Office Action at 4. The Board

agreed with the reasoning of the examiner and further found that an “artisan skilled in the image display and memory arts would have been well aware of the restructuring and manners of address which would need to be changed in order to substitute one type of memory for another.” Ex parte Beasley, Appeal No. 2001-2202, Paper No. 38, at 6 (B.P.A.I. Aug. 29, 2002). I see no error in the Board’s reliance on the PTO’s own specialized knowledge. The effect is merely to create a *prima facie* case, and to shift the burden to the patent applicant. Here the applicant did not refute the factual findings of the Board and the patent examiner, but merely offered lawyer argument to contradict the Board’s findings. Under these circumstances the application was properly rejected.

With this said, I agree that the MPEP provision in effect at the time is not a model of clarity and can be read as recognizing only a very limited scope for the use of the PTO’s expertise. MPEP § 2144.03 (7th ed. 1998). However, the current version appears to allow greater latitude. MPEP § 2144.03 (8th ed., rev. 2, 2004). In future cases, where the PTO has provided us with an interpretation of the new MPEP provisions, we will need to address the extent to which the new version of the MPEP gives the PTO greater scope to rely on its own expert knowledge.